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Robert Peccia &
Associates
Solid waste
management and
resource recovery
study for Gallatin
County, Montana

Solid Waste Management & Resource Recovery Study

Phase One, Final Report

Prepared for: Gallatin County, MT
April, 1984

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ROBERT PECCIA & ASSOCIATES / BLACK & VEATCH
P.O. Box 4518
Helena, MT 59604

April 16, 1984

Gallatin County Technical Review Committee
Gallatin County Courthouse
Bozeman, Montana 59715

Re: Solid Waste Management and Resource Recovery Study

To the Committee Members:

In accordance with our engineering agreement dated June 16, 1983, the firms of Robert Peccia & Associates and Black & Veatch are pleased to submit 25 copies of the Final Phase One Report for the referenced project.

This study was funded through a grant from the State of Montana Department of Health and Environmental Sciences. The primary purpose of this phase of the project was to evaluate various solid waste resource recovery alternatives for the county and make recommendations as to the feasibility of proceeding with a more detailed analysis of the most applicable and feasible resource recovery alternative(s). This detailed analysis would be conducted as Phase Two of this project.

We appreciate the opportunity to conduct this study for you. If you desire additional information or if you decide to proceed to Phase Two, please call at your convenience.

Respectfully submitted,

Robert J. Peccia

Robert J. Peccia

RJP/mje

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SOLID WASTE MANAGEMENT

AND RESOURCE RECOVERY STUDY

FOR

GALLATIN COUNTY, MONTANA

PHASE ONE

FINAL REPORT

APRIL, 1984

Prepared By:

Robert Peccia & Associates
Black & Veatch

The funding of this project was made possible through a grant obtained from the State of Montana Department of Health & Environmental Sciences.

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INTRODUCTION

A. BACKGROUND

During the spring of 1983, a technical advisory committee was formed at the request of the Gallatin County Commission. The purpose of this committee was to oversee and direct the preparation of a detailed study to evaluate the feasibility of utilizing the solid waste generated in Gallatin County as an energy source. The committee that was selected to oversee this study is comprised of several individuals who may be affected by the study results, including various city and county officials, local refuse haulers, representatives of possible energy customers, board members of refuse disposal districts, and interested citizens.

The initial decision of the advisory committee was to select a qualified engineering consultant to conduct the necessary studies and analyses for the project. After interviewing several consultants, the committee retained the joint venture of Robert Peccia & Associates based in Helena, Montana and Black & Veatch, based in Kansas City, Missouri. Through the combined efforts of the advisory committee and the consultant, a grant application was prepared and submitted to the Montana Department of Health and Environmental Sciences, Solid Waste Management Bureau, to fund the project. In June, 1983, the Bureau offered a $77,000 grant to Gallatin County to conduct the study.

As indicated in the grant, the scope of work for this study was divided into two phases. The purpose of the Phase One portion of the study was to identify and evaluate various waste-to-energy alternatives that are potentially feasible. The final result of these analyses would be a recommendation of whether or not to proceed with a more detailed analysis (Phase Two) for the most applicable and feasible resource recovery alternatives evaluated. It was intended that the Phase One analyses be rather general in nature, while the Phase Two analysis would be substantially more detailed and site-specific. The anticipated scope of work for the Phase Two analysis would include: 1) analyses of specific site constraints and impacts; 2) final evaluation of equipment and facility requirements; 3) refinement of facility and system costs; and 4) refinement of financing and acquisition options.

Included in the following text are the results of the analyses conducted for the Phase One portion of this study.

B. SCOPE OF WORK (PHASE ONE)

Initially, a detailed scope of work was developed by the Gallatin County Solid Waste Review Committee with cooperation and guidance from several local and state officials. The work elements deemed applicable were developed such that the recommendations could be utilized to formulate a workable solid waste management plan with an emphasis on resource recovery for the County. Included herein is a summary of the work elements considered for this phase of the project:

1. Identification of current and future demographic conditions within Gallatin County, including general land use and population characteristics for the various geographic areas within the County.

2. Identification and evaluation of current solid waste management conditions within the County, including solid waste storage, collection, transfer and disposal operations and facilities.

3. Review of existing waste generation information and records for all disposal sites within the County, including the Bozeman and Logan landfills and the West Yellowstone transfer station.

4. Identification of typical landfill user characteristics, solid waste volumes and waste composition through the analysis of landfill records and one-week surveillances at the two landfills in Gallatin County.

5. Identification of the physical and chemical composition of wastes including the refuse-to-energy potential, recyclability, and need for special handling and disposal techniques.

6. Evaluation of the market potential for a refuse-to-energy facility located in Gallatin County, including an analysis of the economics, energy consumption and projected energy requirements for potential users.

7. Identification of required on-site processing and utilization facilities; preliminary design cost estimates, and necessary contract negotiations for those market situations that appear to be feasible.

8. Identification and evaluation of various types of energy recovery technology with respect to applications, nationwide success and failure rates, and facility costs.

9. Preliminary identification of potential facility sites, operating costs and probable revenues from energy sales, acquisition and financing methods, and the effects of each on the feasibility of an energy recovery facility located within the County.

10. Development of an economic model of the facility to analyze costs and revenues over the project's design life using a range of inflation rates and other economic parameters.

11. Identification of the economic feasibility of resource recovery by comparing revenues to costs and incorporating other considerations such as future haul costs and remaining landfill life.

12. Preparation of a report that summarizes all findings of the data collection, evaluations and economic feasibility analyses of the study in conjunction with a recommendation to the County regarding the desirability of proceeding with further efforts toward implementation of resource recovery options.

PART TWO

STUDY AREA DESCRIPTION

PART TWO

STUDY AREA DESCRIPTION

A. GENERAL

The study area for this Solid Waste Management and Resource Recovery Study consists of all areas within Gallatin County, Montana. Gallatin County, which is located in south western Montana, is bordered to the north by Broadwater and Meagher Counties, to the east by Park County and Yellowstone National Park, to the south by the State of Idaho, and to the west by Madison and Jefferson Counties. Major communities within the County are Bozeman, the county seat; Belgrade, Manhattan and Three Forks, which are farming communities located in the Gallatin Valley; and West Yellowstone, located in the extreme southern tip of the County adjacent to Yellowstone National Park.

Land use within Gallatin County is reflective of the physical nature of this region of Montana. Much of north central Gallatin County lies within the Gallatin Valley, which is characterized by flat to gently rolling terrain. This area is heavily utilized for agricultural purposes due to the extremely fertile soils of the area and abundant sources of water. The terrain in the eastern portion and much of the southern half of the County is mountainous with narrow river and creek valleys. Notable topographic features in these areas of the County include the Bridger Range, which rises to the north and east of Bozeman, and the steep-walled Gallatin Canyon. Approximately 54 percent of the land in Gallatin County is owned privately and the remainder is under the administration of Federal or State Government. These public lands are primarily comprised of the Gallatin and Helena National Forests. Numerous recreation sites, including a ski area and campgrounds, have been developed on these Federal and State lands.

During the last two decades, Gallatin County has experienced significant growth in both the population and the economy. The majority of this growth has occurred in the Bozeman and Belgrade areas, and may be attributed to the increasingly important role of the City as a trade and services center and the continuing growth of Montana State University. The population of the County increased by nearly 32 percent between 1970 and 1980 after experiencing a 25 percent increase during the previous decade. Since changes in population directly affect the economy of an area, it is reasonable to adopt an optimistic forecast regarding the future economy of the County.

B. POPULATION

1. General

For the purposes of this study, the populations of three geographic areas within Gallatin County are of importance. These areas include: The Gallatin County Refuse District Number One (Logan Landfill Service Area), which is comprised of the western portion of the County; the West Yellowstone/Hebgen Basin Solid Waste District, located in the extreme southern end of the County; and the Bozeman Landfill Service Area, which includes the City of Bozeman and all other portions of the County that do not lie in either refuse district. Figure 1 depicts the location of each of these geographic areas of the County. Estimates of current population for each of the areas are needed to properly assess the records of waste disposal facility usage kept by operators in each of these areas. The estimates of population and the records of solid waste volumes may be used to determine the waste generation characteristics for the future populations in each area of the County. The following narrative briefly describes each geographic area and presents both 1983 estimates and the Year 2000 projections of population.

2. Bozeman Landfill Service Area

a. Current Population

The Bozeman Landfill Service Area consists of the City of Bozeman, its surrounding 4½-mile planning area (depicted in Figure 1) and all other portions of Gallatin County which do not lie within the boundaries of Gallatin County Refuse District Number One or the West Yellowstone/Hebgen Basin Solid Waste District. This area is presently experiencing the majority of the County's growth in permanent residents. Primary growth areas are located within a ten-mile radius of Bozeman; in the Four Corners-Gallatin Gateway Area, and in the Gallatin Canyon, particularly near the Big Sky Resort.

Historical census information for this geographic area of the County indicates that the population of Bozeman and especially its surrounding areas grew significantly during the 1970's. Information contained in the 1983 update of the Master Plan for Bozeman and its surrounding planning area indicates that the population of that area has increased approximately 4.5 percent since 1980. Utilizing the Bozeman Master Plan's population estimates for the City and its planning area and the applicable growth rates for rural Gallatin County, the 1983 population of the Bozeman Landfill Service Area is estimated to be 34,171. This figure represents a six percent increase over the 1980 population for the same area.

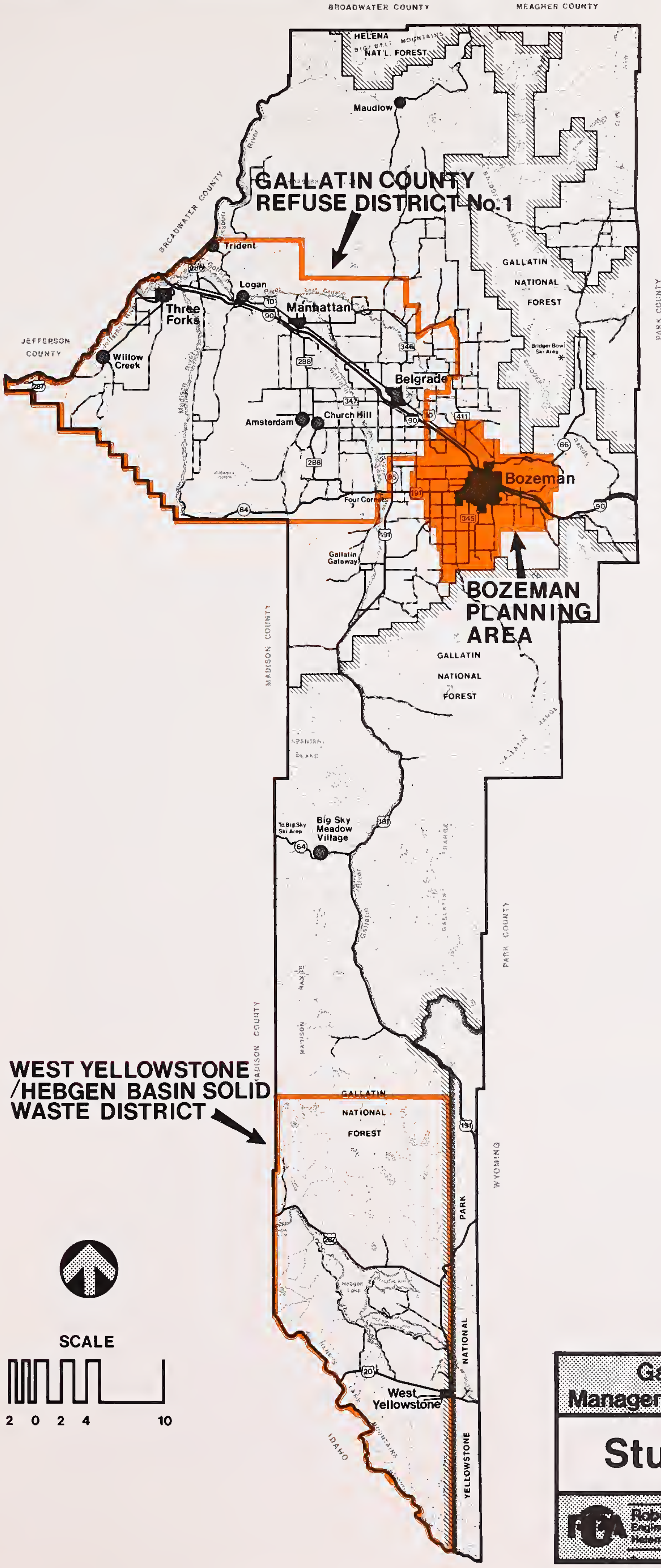


FIGURE 1

Gallatin County Solid Waste Management & Resource Recovery Study

Study Area Location

Robert Peccia & Associates
Engineers · Planners · Designers
Helena, Montana

Black & Veatch
Engineers · Architects
Kansas City, Missouri

BOZEMAN LANDFILL SERVICE AREA

POPULATION ESTIMATES

	1980	1983
City of Bozeman	21,645	22,457
Bozeman Jurisdictional Planning Area	5,483	5,853
Other County Areas	5,109	5,861
TOTAL	32,237	34,171

b. Year 2000 Population

The population of the Bozeman Landfill Service Area is expected to continue to increase at rates similar to these experienced over the past ten years. The Bozeman City-County Planning Office expects the population of the City to increase at a slightly higher rate than it has over the last decade due to the large amount of residential land annexed to the City during the last several years. Population growth within the Bozeman Planning Area and the surrounding portions of rural Gallatin County is expected to decline somewhat in the future as the demand for rural living space is satisfied. Population growth within Bozeman and the Planning Area is expected to continue in a southerly and westerly direction as community services are extended. Based upon population projections and growth rates established in the Bozeman Master Plan, the population of the Bozeman Landfill Service Area is expected to be 50,403 by the year 2000.

3. Gallatin County Refuse District No. 1 Population

a. Current Population

Gallatin County Refuse District Number One, or the Logan Landfill Service Area, consists of the incorporated communities of Belgrade, Manhattan and Three Forks and the other non-incorporated communities of Amsterdam, Churchill, Logan, Trident and Willow Creek. Lands in this portion of west-central Gallatin County are primarily used as cropland or grazing land for livestock. Scattered industrial development has occurred within the District, especially near Belgrade, Three Forks and Trident.

Historical population data for this portion of Gallatin County indicates that the area grew significantly between 1970 and 1980.

The population of the eastern portion of the refuse district, especially Belgrade and its surrounding area, increased by more than 50 percent during the past decade. The population of Manhattan and its surrounding area increased by more than 20 percent over the same period. Growth in the three Forks area was notably lower as the population increased by less than ten percent for the ten-year period. Utilizing historical growth rates for the areas of the District, the 1983 population is estimated to be 10,275.

GALLATIN COUNTY REFUSE DISTRICT NO. ONE

POPULATION ESTIMATES

	1980	1983
Belgrade	2,336	2,600
Manhattan	988	1,000
Three Forks	1,247	1,275
Other District Areas	5,122	5,400
TOTAL	9,693	10,275

b. Year 2000 Population

The population of Gallatin County Refuse District Number One is expected to increase substantially in the future. The majority of the growth in the refuse district is expected to occur in and around the Town of Belgrade due to its proximity to Bozeman and its continuing role as a "bedroom community" for Bozeman. Other portions of the refuse district are expected to experience slow to moderate growth as lands are predominantly used for agricultural purposes. Based upon population projections obtained from local officials and County Planners, the population of Gallatin County Refuse District Number One is projected to be 15,180 by the Year 2000. This figure represents a 48 percent increase in population over the 1983 estimate.

4. West Yellowstone/Hebgen Basin Solid Waste District

a. Current Population

The West Yellowstone/Hebgen Basin Solid Waste District boundary coincides with Gallatin County School District Number 69. The District consists of the Town of West Yellowstone and the extreme southern tip of Gallatin County. This portion of the County is ad-

jacent to Yellowstone National Park and much of the District lies within the Gallatin National Forest. The area experiences large seasonal fluctuations in population and commercial activity due to the numerous recreational opportunities available on nearby public and private lands. In addition to West Yellowstone, major areas of both residential and commercial development exist on the shores of Hebgen Lake and between Targhee Pass and West Yellowstone.

Census data for the West Yellowstone area indicates that during the 1970's the populations of the Town decreased by about three percent, however the surrounding area increased by 25 percent. This in indicative of the continuing development of numerous residential subdivisions surrounding Hebgen Lake. Using a growth rate similar to that experienced by this portion of Gallatin County, the 1983 population of the West Yellowstone/Hebgen Basin Solid Waste District is estimated to be 991.

WEST YELLOWSTONE/HEBGEN BASIN SOLID WASTE DISTRICT

POPULATION ESTIMATES

	1980	1983
West Yellowstone	735	779
Other District Areas	200	212
TOTAL	935	991

b. Year 2000 Population

The population of the West Yellowstone/Hebgen Basin Solid Waste District is expected to continue to increase through the Year 2000. Growth will probably occur in the same areas that are presently expanding, since residential subdivisions have not yet reached full development. A recent land exchange between the Forest Service and the Town of West Yellowstone should also allow for development in the future. The Yellowstone National Park Master Plan calls for visitor usage in the Park to be restricted in the future. This Plan indicates that overnight accommodations within the Park will be limited at a future date and the surrounding or "gateway" communities will be expected to provide the facilities necessary to provide for the numbers of visitors exceeding the maximum overnight capacity of facilities in the Park. Commercial opportunities and subsequent development will undoubtedly occur in the West Yellowstone area at the time this policy is implemented. Ski Yellowstone, a ski area and resort development, is

planned for an area north of West Yellowstone near Hebgen Lake. Environmental, legal and economic problems have postponed construction on the project for the past several years. Residential and commercial activity within the area would increase significantly if the Ski Yellowstone Project becomes a reality.

Based upon historical growth rates for the area and the most likely scenario for future development of the West Yellowstone area, the population of the West Yellowstone/Hebgen Basin Solid Waste District is projected to be 1,552 by the Year 2000. This figure represents an increase in population of 57 percent over the 1983 estimate for the District.

5. Population Summary

Based upon the data presented in the preceding paragraphs, the existing and projected populations in the county by geographic area can be summarized as follows:

	1983	2000
Bozeman	34,171	50,403
District No. 1	10,275	15,180
West Yellowstone	991	1,552
Total County	45,437	67,135

PART THREE

EXISTING SOLID WASTE MANAGEMENT CONDITIONS

PART THREE

EXISTING SOLID WASTE MANAGEMENT CONDITIONS

A. GENERAL

When evaluating the existing solid waste management situation in a specific area, several major aspects must be addressed. These aspects include: 1) the current laws and regulations which govern the various phases of solid waste management; 2) the operation of existing solid waste storage, collection and transportation services; and 3) the operation and adequacy of existing solid waste transfer and disposal sites. Included in the following narrative is a brief summary of these major aspects as they relate to this project in Gallatin County.

Obviously, there are several other aspects that are directly related to the total solid waste management system in the area. These include: 1) the recovery and recycling of solid waste; 2) the disposal of special and hazardous type wastes; and 3) the economic, organizational and institutional aspects of the existing and proposed solid waste programs and systems. These aspects will be discussed in subsequent chapters of this report.

B. APPLICABLE LAWS AND REGULATIONS

There are basically three degrees of laws and regulations which directly affect the management of solid waste in the study area. These include: 1) local ordinances; 2) State of Montana disposal laws and rules; and 3) federal laws and regulations. Included in the following text is a brief discussion of the various laws and regulations which directly affect the management of solid waste in the study area.

1. Local Ordinances

Most of the incorporated communities within Gallatin County have adopted local ordinances which require solid waste to be properly disposed of. These ordinances deal primarily with local conditions such as littering, burning and solid waste collection and disposal procedures.

2. State of Montana Laws and Regulations

The state laws concerning solid waste management were initially adopted by the 1965 State Legislature. Since that time, the regulations have been amended several times. The laws and regulations set forth by the State of Montana include legal and administrative control over all phases of solid waste management including the following: 1) facility li-

censing; 2) standards for the operations and maintenance of facilities; 3) facility classification; 4) solid waste transportation and disposal of hazardous wastes; 5) litter control; 6) disposal of dead animals; 7) feeding garbage to animals; 8) nuisances; and 9) disposal of junk vehicles.

Included in the following narrative is a brief summary of the principal rules and regulations which are included in the State Solid Waste Management Act as amended in 1977. A copy of the complete rules and regulations can be obtained from the State Department of Health and Environmental Sciences, Solid Waste Management Bureau.

a. Disposal Site Licenses

Under the present state laws, all sanitary landfill sites must be licensed by the State Department of Health and Environmental Sciences, Solid Waste Management Bureau. The Department has established three classifications for refuse disposal sites. A summary of the three classifications is included below:

1) Class I

Class I sites may accept all groups of waste including hazardous wastes. Class I sites shall not discharge these materials or their by-products to ground or surface waters. These sites must either confine the wastes to the disposal site with no likelihood that the wastes will escape, or they must be situated in a location where the leachate from the wastes can only percolate into underlying formations which have no hydraulic continuity with usable waters.

2) Class II

Class II sites are suitable for accepting decomposable and organic materials, wood and demolition materials, and digested wastewater sludges. The site must provide for separation of these type materials from underlying or adjacent usable water. The distance of the required separation is established on a case-by-case basis, considering factors such as terrain, type of underlying soil formation, and natural quality of the groundwater.

3) Class III

Class III sites are suitable for accepting only inert-type materials, excluding potentially hazardous wastes. The site may contain water such as in marshy areas which contain exposed groundwater or areas which may be periodically flooded, such as along stream floodplains. Class III sites shall not be located on the banks or in a live or ephemeral stream.

The Department of Health and Environmental Sciences may issue a conditional license for solid waste management systems already in existence or under construction on the effective date of this rule. Such a license, if granted, will be valid for up to one year. Only when the Department determines that the conditional licensee

has shown good cause for an extension will one be granted. Conditional licenses are to be granted only if the applicant demonstrates that steps are being taken to bring the site into compliance. The local health officer must validate all conditional licenses before they are effective.

The Department may deny or revoke a license to operate a solid waste management system after giving the applicant and the local health officer written notice and an opportunity for a hearing before the Board. The decision to deny or revoke a license may be made only after finding that a solid waste management system cannot be operated or is not being operated in compliance with the state laws and regulations. The hearing held before the Board on a denial or revocation shall be held pursuant to the provisions of the Montana Administrative Procedures Act.

b. Disposal Site Operation and Maintenance Requirements

1) Class I Sites

Due to the hazardous nature of the waste that may be processed at these sites, strict supervision is required when such sites are open. Sites shall be fenced to prevent unauthorized access. All Class I sites using landfilling methods shall cover Group I wastes with a minimum of twelve (12) inches of suitable earth cover material after each operating day and up to four (4) feet of earth cover material within one week after the final deposit of solid waste. These steps must be taken unless the Department is satisfied that the licensee has shown good cause for not covering the waste.

Where other solid waste management methods are proposed to dispose of Group I wastes, the operation and maintenance plan must demonstrate to the Department's satisfaction that such disposal methods pose no danger to man and the environment. Group II wastes disposed of at Class I sites shall satisfy all Class II disposal requirements.

2) Class II Sites

All Class II sites using landfilling methods shall compact and cover solid waste with a layer of at least six (6) inches of approved earth cover material at the end of each operating day and at least two (2) feet of approved earth cover material within one week after the final deposit of solid waste at any portion of the site. These steps must be taken unless the Department is satisfied that the licensee has shown good cause for not covering the waste.

EPA's 1972 publication, <u>Sanitary Landfill Design and Operation</u> (No. SW-65ts), shall be used as the general landfill design and operation manual for the purposes of this rule. The Department may

develop or adopt guidelines for other solid waste disposal methods and procedures. Semi-solids should be mixed with other solid waste to prevent localized leaching, or separate, specialized disposal areas should be developed. Sites shall be fenced to prevent unauthorized access and shall be supervised when open.

Where refuse containers are utilized as part of a management system for Group II solid wastes, all containers shall be maintained and kept in a sanitary manner and emptied at least once a week, unless other arrangements are determined acceptable.

3) Class III Sites

Although these sites are not required to be covered by earth materials daily, they shall be covered periodically.

4) Open Burning

For all classes of sites, the open burning of wastes is prohibited unless a variance has been obtained from the Department.

5) Litter Control

Dumping must be confined to the areas within the disposal site that can be effectively maintained. In addition, effective steps shall be taken to control litter at all facilities.

c. Hazardous Waste Management Systems

The Department may require the maintenance of records, including copies of waste manifests, and the submission of reports from persons who store, treat, or dispose of hazardous wastes. Permanent records must be maintained by the operator of a hazardous waste disposal facility, identifying the location of each disposal area and the waste or waste types disposed of therein. Such disposal records shall be made available to the new facility owner or operator if the facility is sold or leased to another person.

No hazardous waste management system may store, treat, or dispose of hazardous wastes in a manner which is inconsistent with methods approved by the Department.

All hazardous waste management systems are required to have licenses issued by the Department.

Hazardous wastes found in household refuse may be disposed of at Class II disposal sites without written authorization from the Department.

For areas not served by licensed Class I disposal sites, the Department may, upon showing of good cause, authorize the disposal of hazardous wastes at Class II disposal sites if no health hazard or no danger to the environment would be presented.

d. Inspection and Enforcement

The Department has the authority to conduct inspections of solid waste management systems at reasonable hours upon presenta-

tion of appropriate credentials. If, after an inspection, the Department determines that violation of the Act or this rule is occurring, it shall notify the licensee of the nature of the violation. Depending upon the severity of the violation(s), the Department may seek a compliance schedule from the applicant or may initiate proceedings to revoke the license. The Department may also, through the Attorney General or appropriate county attorney, seek to enjoin the licensee or collect a criminal penalty.

e. Loans and Grants

The Department shall provide financial assistance to local governments for front-end planning activities for a proposed solid waste management system which is compatible with the state plan whenever such financial assistance is available.

The Department shall provide front-end organizational loans for the implementation of an approved solid waste management system whenever funds for such loans are available.

f. Refuse Disposal Districts

The state laws give the county commissioners the authority to create solid waste districts for the purpose of collection and/or disposal of refuse. Cities and towns may be included in the district if approved by the city or town councils.

g. Dead Animals

It is unlawful to place all or part of a dead animal in a lake, river, creek, pond, reservoir, road, street, alley lot, or field. In addition, it is unlawful to place a dead animal within one mile of the residence of any person unless the dead animal is burned or buried at least two feet underground.

If a person refuses or neglects to comply with a written order or a state or local health officer within a reasonable time specified in the order, the state or local health officer may cause the order to be complied with and may initiate an action to recover any expenses incurred from the person who refused or neglected to comply with the order. The action to recover expenses shall be brought in the name of the city or county. A person who does not comply with rules adopted by the Board will be guilty of a misdemeanor.

h. On-Site Disposal

The state solid waste laws do not prohibit individuals or industry from disposing of solid wastes on his or her own property as long as such disposal does not create a nuisance or health hazard. A nuisance is defined as "anything which is injurious to health or is indecent or offensive to the senses, or an obstruction to the free use of the property, so as to interfere with the comfortable enjoyment of life or property, or unlawfully obstructs the free

passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin, or any public park, square, street, or highway."

i. Motor Vehicle Wrecking Facility Act

Under this act, each county is to establish a county motor vehicle graveyard where any citizen may place a junk vehicle free of charge. The county is also responsible for establishing a collection program in order to pick up the junk vehicles and place them in the graveyard facility. Other provisions of the law call for licensing and shielding all private motor vehicle wrecking facilities and county motor vehicle graveyards.

j. Penalty for Violations

Any person violating the Act or regulations prescribed by the Department under the Act shall be guilty of a misdemeanor and, upon conviction, shall be fined not less than $50 nor more than $500. Each day upon which a violation of this Act occurs shall be considered a separate offense.

A person who stores, treats, transports, or disposes of a hazardous waste in violation of this chapter, a rule adopted as authorized by this chapter, or an order issued as provided for in this chapter is subject to a civil penalty of not more than $25,000. Each day upon which a violation occurs is a separate violation.

3. Federal Regulations

The federal regulations concerning the proper management of solid waste are included in the "Resource Conservation and Recovery Act of 1976" (RCRA), which is documented as Public Law 94-580. The primary purpose of the law is to suggest guidelines for the proper disposal of solid and hazardous wastes generated in the nation and also to develop guidelines for the proper and safe recovery and re-use of recyclable materials found in the solid waste system.

C. EXISTING COLLECTION SYSTEMS

1. General

For this study, several sources of information concerning the existing solid waste collection services within Gallatin County were utilized. The primary sources that were employed include: 1) interviews and discussions with local officials and private businessmen directly responsible for the administration and operation of solid waste collection systems in Gallatin County; 2) inspections by the Consultant of equipment used for the collection and transfer of solid waste; and 3) review of available reports and materials which have evaluated existing collection systems.

Within Gallatin County, solid waste collection services are offered by the City of Bozeman, Montana State University, and three commercial

services which include the Convenience Disposal Company, Valley Sanitation, Inc., and Westgate Enterprises, Inc. Included herein is a summary of each of the solid waste collection and transfer services available in the study area.

2. City of Bozeman

The City of Bozeman offers a municipal collection service to city residents at a cost of approximately $4.25 per month. This fee includes a weekly door-to-door collection service and a base fee for landfill use. The City utilizes two 20-cubic-yard rear-loading compactors with three-man crews to collect refuse from the residential areas of Bozeman. One City crew is responsible for collecting refuse from the northside of Bozeman, while the other is assigned to the southside. In addition to the rear-loading compactors, a small six-cubic-yard rear-loading compactor (pup) is used to collect refuse from the facilities in the city parks. Other City of Bozeman vehicles are often utilized to transport miscellaneous items such as tree branches or demolition debris to the landfill. The City of Bozeman expects to spend more than $250,000 to provide solid waste collection services to residents during Fiscal Year 1983.

3. Montana State University

Montana State University currently utilizes a 19-cubic-yard rear-loading compactor to collect solid wastes from all facilities on the campus. Refuse is collected five times per week during the summer months and approximately six times per week during the school year. Other University vehicles are utilized to haul refuse generated by the Physical Plant, Grounds Department or Animal and Range Sciences Department. The University plans to purchase a new 20-cubic-yard rear-loading compactor in the near future to replace their present collection vehicle.

4. Three Rivers Disposal

This company recently purchased the Convenience Disposal Company. The company offers solid waste collection service to approximately 4,000 residences and 1,000 commercial customers in Gallatin County. The company provides collection services to residents and businesses located in and around Bozeman, Big Sky and Gallatin County Refuse District Number One, which includes the Belgrade, Manhattan and Three Forks areas. Refuse generated by residential customers is collected at least once per week. Commercial collection schedules range from twice per month to once per week for large generators utilizing open top or compacting roll-off containers to twice per week for smaller commercial operations. Gallatin County Refuse District Number One typically solicits bids from commercial refuse haulers for a five-year service agreement to collect and transport wastes to area landfills. As of January 1, 1984, Three Rivers Disposal initiated a five-year contract for this purpose.

5. Valley Sanitation, Incorporated

Valley Sanitation, Incorporated, which is headquartered in Bozeman, also offers solid waste collection services to both residential and commercial subscribers in Gallatin County. Valley Sanitation currently provides collection services to subscribers located within Bozeman and its surrounding areas. Residential solid wastes are collected once per week and commercial wastes are typically collected between two and six times per week. Large commercial establishments and manufacturing firms utilize open-top or compacting roll-off containers, and collection schedules vary from once per week to as many as four times per week depending upon the needs of the subscriber. Many commercial subscribers are provided with "green box" containers which promote fast, efficient handling of refuse.

6. Westgate Enterprises, Incorporated

Westgate Enterprises, Incorporated is located in West Yellowstone and provides solid waste collection services to residents and commercial establishments in the West Yellowstone area.

Westgate collects waste from an area that includes much of the extreme southern portion of Gallatin County. This service area extends from the junction of Highways 287 and 191 on the north to the Gallatin County - Madison County line on the west, and to the Idaho border on the south. Refuse generated by residential units in the area is collected once per week and transported to the transfer station north of town via a 15-cubic-yard rear-loading compactor. Commercial refuse is collected on a schedule which ranges from one to six times per week, depending on the needs of the individual business. Commercial refuse is collected by two front-loading compactors with capacities of 25 and 30 cubic yards. Many businesses within the West Yellowstone area are equipped with three- to four-cubic-yard dumpsters which facilitate refuse collection.

7. National Park Service

The National Park Service is responsible for collecting the majority of the wastes generated within the boundaries of Yellowstone National Park. NPS personnel utilize two 14-cubic-yard rear-loading compactors and pickups to collect refuse from facilities within the western district of the Park. Major facilities in this district include one camping area, nine picnic areas, and lodging facilities at Old Faithful.

Wastes are collected each day from "bear-proof" containers and are transported directly to the West Yellowstone transfer station in the collection vehicles. Most of the wastes collected by the NPS are generated between May 15 and October 31 each year.

8. U.S. Forest Service

The Forest Service maintains six campgrounds within the Gallatin National Forest near West Yellowstone. Refuse generated at these sites is collected each evening by the Forest Service in an effort to avert problems with bears. Usage of these sites is similar to that for the

Yellowstone Park facilities. Forest Service personnel utilize a three-cubic-yard rear-loading compactor to collect and transport wastes to the transfer station near West Yellowstone. Forest Service personnel occasionally transport refuse from other areas of the Gallatin National Forest such as Hyalite Canyon or the Spanish Peaks to the Bozeman landfill for disposal. As previously mentioned, refuse at other Forest Service facilities within the Gallatin Canyon is collected on a contract basis by Convenience Disposal Company of Bozeman.

D. EXISTING DISPOSAL FACILITIES

1. General

Solid wastes collected within Gallatin County by the numerous public and private collection services are ultimately disposed of at landfills located near Bozeman and Logan or transported via the solid waste transfer station located north of West Yellowstone to Ennis. Information regarding the physical characteristics, operational procedures, and management policies of each facility was compiled from a number of sources which included: 1) on-site inspections of each facility by the Consultant; 2) conversations with managers and operators of each facility; 3) review of State licensing and inspection reports; and 4) review of current and past reports and correspondence which have evaluated the operation and management policies of the existing facilities. The following narrative briefly discusses the current operation and management practices of each solid waste disposal facility located in Gallatin County. Figure 2 depicts the location of each disposal site and the typical service area of the facility as determined through interviews with landfill users.

2. Bozeman Landfill

The City of Bozeman operates and maintains a Class II landfill located one mile northeast of the community on Story Mill Road. The solid waste disposal site consists of 200 acres of City-owned land, of which approximately 55 acres are usable. The estimated remaining landfill life is seven years.

The entire site is fenced, and an eight-foot-high fence has been placed along the eastern perimeter of the site to contain windblown paper. The approach road to the site is well maintained by the County; however, the portion of Story Mill Road which extends north from the access to the landfill site may be impassible during some wet conditions. Roads within the landfill site are also well maintained to provide all-weather access for vehicles using the disposal site. Within the site, the daily dumping area is defined through the use of signs, and special waste types such as tires, branches, etc. are segregated according to type.

Access to the site is controlled by a lockable gate and an attendant stationed near the gate during operating hours. The Bozeman landfill is open from 8:00 a.m. to noon and from 1:00 p.m. to 5:00 p.m. on Mondays and from 8:00 a.m. to 6:00 p.m. each Tuesday through

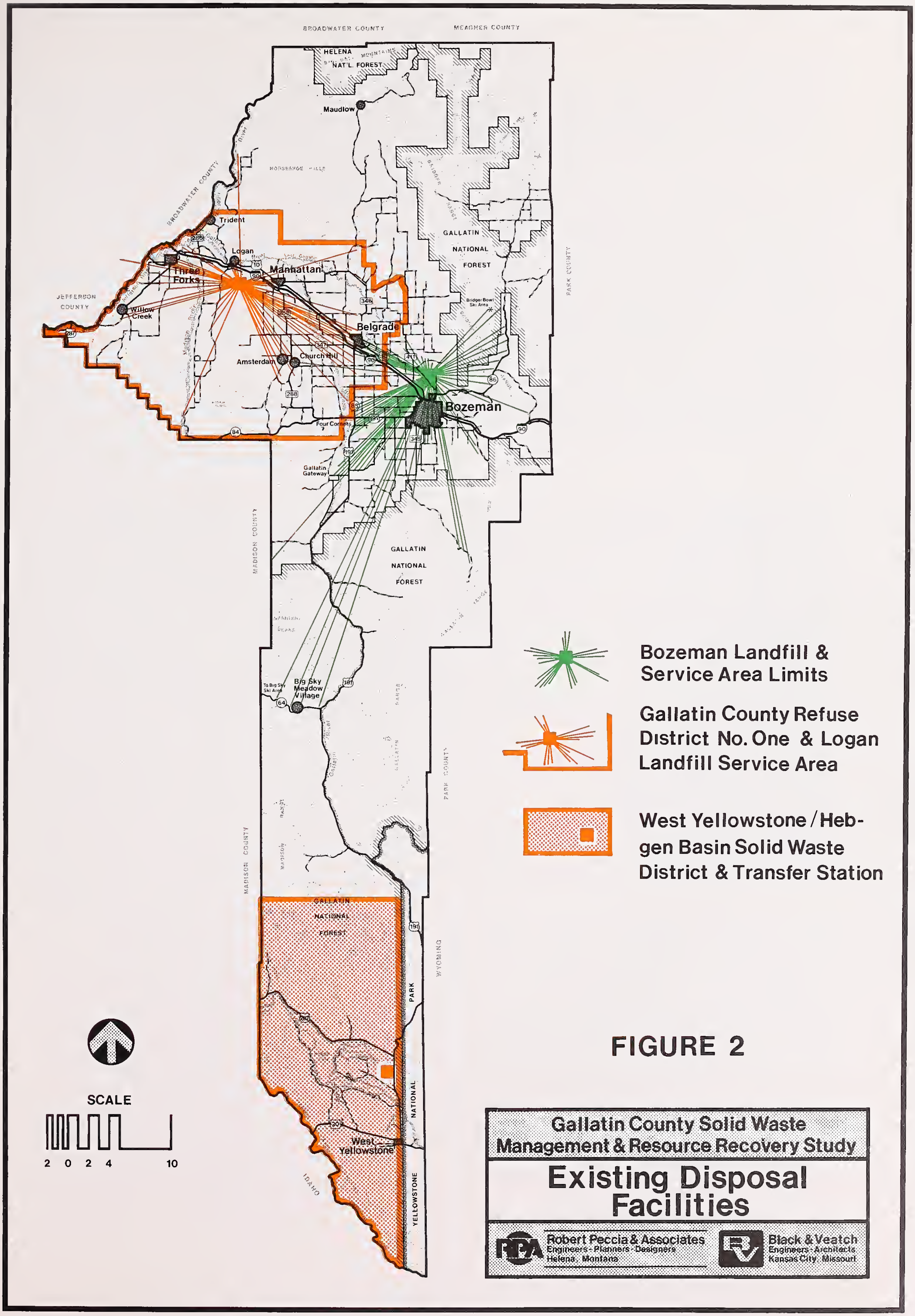


FIGURE 2

Gallatin County Solid Waste Management & Resource Recovery Study

Existing Disposal Facilities

Saturday. One of the two landfill operators is present at the site by 7:00 a.m. every Tuesday through Saturday to open the gate for commercial haulers only. The City has supplied both commercial haulers in the Bozeman area with landfill gate keys to facilitate dumping prior to 7:00 a.m.

The City of Bozeman utilizes two track-type dozers to maintain and cover the landfill operation. One dozer is owned by the City and the other is leased; however, maintenance of both dozers is the responsibility of the landfill operators. Both loaders are kept in a heated storage building located within the landfill site. Two part-time gate attendants are responsible for levying charges to all persons wishing to use the landfill, including City personnel and vehicles. These fees are based on typical load sizes for various types of vehicles that utilize the landfill and the type of waste materials that will be disposed of at the landfill. The City of Bozeman expects to spend nearly $173,000 for operation of the landfill during Fiscal Year 1983.

3. Logan Landfill

Gallatin County Refuse District Number One manages a solid waste disposal facility which is located approximately one mile southeast of the community of Logan. This facility is fully licensed as a Class II site by the Montana Department of Health and Environmental Sciences, and may accept Group II and Group III wastes for disposal. The site consists of 80 fenced acres, of which about 55 acres are usable. At the present rate of landfill use, it is estimated that the site will be usable well beyond the end of the planning period in the year 2000.

Access to the site is limited by a lockable gate and a caretaker who lives on-site. The approach roads to the landfill have been well maintained, and much of the road has been paved for all-weather access. During the summer (April 1 to October 31), the Logan landfill is open from 7:00 a.m. to 5:00 p.m. each Monday through Friday and from 7:00 a.m. to 4:00 p.m. on Saturdays. Throughout the winter months (November 1 through March 31), the facility is open from 8:00 a.m. to 5:00 p.m. each Monday through Friday and from 9:00 a.m. to 4:00 p.m. each Saturday.

Gallatin County Refuse District Number One typically solicits bids from private contractors to operate and maintain the Logan landfill. A new service agreement for a five-year period was recently awarded to Harvey Van Dyken & Sons, a Manhattan-based contractor. This contractor utilizes a track-type dozer equipped with a front-end bucket. At the time of the on-site inspection by the Consultant, the contractor was moving large amounts of earth in an effort to fully reclaim previously used portions of the site. The contractor is responsible for providing supervision during the time waste materials are unloaded, and must collect fees from non-District users of the landfill or from District members disposing of selected special wastes. A minimum fee of $2.00 per load is assessed to landfill users who do not reside within the District. District

members are assessed a $2.00 per cubic yard fee for disposal of tires, wire, or construction debris materials.

A site evaluation of the Logan landfill was performed by the Soil Conservation Service in 1975. This study indicated that the conditions at the site are suitable for disposal of Group II wastes with a very low pollution potential to surface waters and a low to moderate pollution potential to groundwaters, provided care is taken during landfill operations. The report recommended that future excavations at the site occur north of two coulees that cross the site and that chemical analysis of groundwater in the area be conducted at regular intervals.

4. West Yellowstone Solid Waste Transfer Station

The West Yellowstone/Hebgen Basin Solid Waste District recently constructed a solid waste transfer station at the former landfill site located approximately four miles north of West Yellowstone. Operation of the transfer site and maintenance of the Class III landfill at the site have been contracted out to Westgate Enterprises, Inc. of West Yellowstone. This initial contract, which extends over a five-year period, requires the Contractor to maintain all on-site facilities and to transport all wastes from the transfer station to the licensed landfill near Ennis for final disposal.

The Contractor utilizes a one-half-cubic-yard bobcat loader to push wastes from the tipping floor of the facility into the trailers. The wastes delivered to the transfer station are loaded into one of two 75-cubic-yard compacting trailer units and transported as needed by truck to the Ennis landfill. Currently, the contractor makes an average of five trips per month during the winter months (November through April) and as many as 20 to 25 trips per month during the peak summer months (June through August). The facility is open from noon to 7:00 p.m. for the entire week between May 1 and November 1 each year and for four hours two days per week from November 1 through May 1. The Class III disposal site is maintained with two Caterpillar dozers and a four-cubic-yard loader.

Residential units in the West Yellowstone/Hebgen Basin Solid Waste District are assessed a fee of $66.25 per year to cover transfer station operations (this excludes door-to-door fees which are assessed on an individual basis). Charges for commercial establishments are based upon the volume of waste generated by each operation in comparison to the volume of waste generated by a typical residential unit. This method of "equivalent household units" allows commercial establishments to contribute their proportionate share of the facility costs. Non-District members are assessed a fee for use of the facility.

PART FOUR

SOLID WASTE QUANTITIES

PART FOUR

SOLID WASTE QUANTITIES

A. GENERAL

In order to design an efficient solid waste management plan, the quantity and characteristics of the waste generated within the study area must be evaluated. The identification of waste volumes requires that the demographic conditions and waste generation characteristics of the study area be established. For example, in Gallatin County most of the wastes are generated by residents, small businesses and industries; however, significant quantities of waste are also generated by the large number of tourists visiting the area each year. An important and useful tool in the evaluation and design of any existing or proposed solid waste system is the per capita generation or the pounds per capita per day of solid waste generated within a specific area.

From the Consultant's experience and from studies completed by various governmental groups, it has been determined that the per capita generation varies with population density. Large urban areas generate a higher per capita rate because of the large numbers of industrial and commercial establishments in these areas. Small towns generally have some commercial wastes but have very little industrial wastes. Rural areas with little or no commercial or industrial activity generate relatively small amounts of refuse consisting primarily of household wastes.

The solid wastes generated within Gallatin County may be classified as processable or non-processable waste materials. Processable wastes consist of Group II wastes generated by county residents or through the operation of commercial businesses. These wastes include those materials which may be readily recovered through recycling programs or a refuse-to-energy facility. The remainder of the solid wastes generated in the County are considered to be non-processable. These waste materials include construction/demolition debris, large bulky items, organic wastes, and inert and fill material. Hazardous waste materials generated in the County are also considered to be non-processable waste materials. Both types of waste materials will be discussed in the following narrative. In addition, this section will contain an analysis of existing disposal site records, an analysis of solid waste composition, and estimates of current and future solid waste quantities in Gallatin County.

B. PROCESSABLE WASTES

1. General

During the course of this study, one-week surveillances were conducted at the Bozeman and Logan landfills. During each surveillance, the driver of each vehicle was interviewed and the time of arrival, type of vehicle, type of hauler, and vehicle's origin were recorded. These surveys were used to estimate the types and quantities of waste that are transported to each facility during a typical week of operation. The information obtained through these surveys was utilized to establish service areas and to identify the portion of wastes which could be available for processing at a refuse-to-energy facility. The following narrative will briefly discuss the results of each surveillance and their relationships to current and projected waste quantities.

2. Current Waste Quantities

a. Bozeman Landfill Service Area

The City of Bozeman maintains a record of landfill use based on the number and size of vehicles used to transport wastes to the disposal site. These monthly records further identify the number of vehicles by hauler type including the City of Bozeman, commercial collection services, Montana State University, building contractors and the general public. Waste quantities are then estimated by the City using vehicle counts and typical waste volumes for each vehicle. During the consultant's survey of the Bozeman landfill, many of the compactor vehicles were weighed in an effort to determine average densities for each vehicle. These average densities, in conjunction with the number of trips each vehicle made over the past two years, were used to estimate waste quantities. Average densities per vehicle established through previous studies by the consultant and governmental agencies were used in the same manner to estimate quantities for other vehicle types. Based on these assumptions, monthly quantities of solid waste were estimated for each of the past two years. The totals for each year were averaged together in an effort to compensate for the notable variance in yearly totals. Using this method, it is estimated that approximately 25,908 tons of solid waste will be deposited at the Bozeman landfill during 1983.

The surveillance at the Bozeman landfill was also used to determine the portion of wastes that could be processed at a refuse-to-energy facility. The waste transported by each vehicle entering the landfill was categorized, and an overall breakdown of processable vs. non-processable wastes was determined for all vehicles. These percentages and the number of vehicles were used to determine the monthly quantity of processable waste for each of the past two years. These monthly figures were then used to derive a two-year average. Based on this analysis, it is estimated that 22,408

tons of the total quantity of solid waste deposited at the Bozeman landfill during 1983 would be considered processable.

Utilizing the 1983 estimate of population for the Bozeman landfill service area of 34,171, the overall waste generation rate was determined to be 4.15 pounds per capita per day. Correspondingly, processable wastes in the Bozeman area are generated at a rate of 3.59 pounds per capita per day.

b. Gallatin County Refuse District Number One

An analysis of the records of Gallatin County Refuse District Number One indicates that no accurate record of the quantity of solid waste deposited at the Logan landfill exists. However, the new operator began to keep a record of commercial collection service usage and a general vehicle count as of June 1, 1983. Since no other data exists regarding waste quantities, information obtained during the week-long surveillance at the site was used as much as possible as a basis for analysis. Records of vehicle traffic for June and July were obtained from the landfill operators, and assumptions regarding vehicle numbers and types were based on the results of the survey. The average waste density by vehicle type calculated during the survey at the Bozeman landfill was also used to determine the waste quantities for June and July. In order to estimate the total waste quantity for the year, it was necessary to estimate the portion of the total that these monthly quantities represented. Since no other local data existed, it was assumed that monthly waste generation and landfill use within the Refuse District were similar to that experienced in the Bozeman area. Based on this assumption, it is estimated that approximately 6,900 tons of solid wastes will be deposited at the Logan landfill in 1983. Processable wastes will account for approximately 5,600 tons or 81 percent of the total. The waste generation rate for the 10,275 residents of Gallatin County Refuse District Number One is estimated to be 3.69 pounds per capita per day. Processable wastes are generated at a rate of 3.00 pounds per capita per day.

c. West Yellowstone/Hebgen Basin Solid Waste District

The operator of the West Yellowstone solid waste transfer station has maintained a record of disposal site use since the facility opened in November, 1982. The records of solid waste quantities are assumed to be quite accurate since the District is charged for each yard of waste deposited at the Ennis landfill. Records of facility use exist for most of the operational year; however, monthly waste quantities for August, September and October had to be estimated. Since a Class III disposal area is still maintained on the site, the refuse transported to the Ennis landfill represents the processable portion of the wastes generated in the area. Based on these records and assumptions, it is estimated that approximately 2,700 tons per year of processable solid waste are presently being

deposited at the West Yellowstone facility. No records of Class III landfill use are maintained by the operator or the District. As a result, the total quantity of waste deposited at the West Yellowstone disposal site was estimated to be approximately 15 percent greater (3,096 tons) than the processable waste total. If the waste quantities generated at National Park Service and Forest Service sites in the area are subtracted from the District totals, waste generation rates for District residents are approximately 6.00 pounds per capita per day. This rate is higher than for other areas in the County due to the proportionally large amount of commercial and tourism-related wastes generated in West Yellowstone.

d. Gallatin County

Based upon the previous analysis and estimates of solid waste quantities for the three geographic areas of the County, it is estimated that 35,903 tons per year of solid wastes are currently generated and disposed of in Gallatin County. Processable wastes comprise approximately 86 percent of the overall total, or 30,728 tons. Both Table 1 and Figure 3 summarize the 1983 estimates of monthly solid waste quantities for the three major geographic areas of the County. Overall waste generation rates for the County were determined to be 4.32 pounds per capita per day for all waste materials and 3.70 pounds per capita per day for processable wastes. These waste generation rates are representative of those experienced in other areas of Montana. During the course of the State of Montana Solid Waste Management and Resource Recovery Study completed in 1976, landfill surveillances were conducted at ten disposal sites within the state. The results of these surveillances indicated that the average waste generation rate for all residents of Montana was estimated to be 4.28 pounds per capita per day.

3. Projected Waste Quantities

a. Bozeman Landfill Service Area

Based on the projections of future population for the Bozeman area compiled by the local planning organization and the current waste generation rates determined for Bozeman area residents, it is estimated that by the year 2000 approximately 38,214 tons per year of solid waste will be available for processing and disposal. Processable wastes are expected to account for 33,052 tons of this yearly total. These projected year 2000 quantities represent a 47 percent increase over the 1983 estimates of waste quantities.

b. Gallatin County Refuse District Number One

Projections for the year 2000 waste quantities for Gallatin County Refuse District Number One were based on the projected population and the current waste generation rate for the District. It

TABLE IV-1

1983 GALLATIN COUNTY SOLID WASTE QUANTITIES

Month	Bozeman Landfill Service Area[1]		Gallatin Co. Refuse Dist. No. One[2]		Subtotal		W. Yellowstone/ Hebgen Basin District[3]		Total	
	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons
January	1871.9	1682.4	498.8	420.9	2370.7	2103.3	123.6	107.5	2494.3	2210.8
February	1943.1	1766.3	517.4	441.6	2460.5	2207.9	103.5	90.0	2564.0	2297.9
March	2364.1	2138.9	629.9	557.7	2994.0	2696.6	106.4	92.5	3100.4	2789.1
April	2482.4	2165.2	661.0	541.4	3143.4	2706.6	107.8	93.7	3251.2	2800.3
May	2304.1	1966.6	614.0	492.0	2918.1	2458.6	258.7	225.0	3176.8	2683.6
June	2578.3	2129.6	686.4	532.5	3264.7	2662.1	431.3	375.0	3696.0	3037.1
July	2557.5	2101.2	681.0	525.7	3238.5	2626.9	546.3	475.0	3784.8	3101.9
August	2410.2	2013.9	641.6	503.9	3051.8	2517.8	517.5	450.0	3569.3	2967.8
September	2078.9	1795.8	553.3	448.9	2632.2	2244.7	431.3	375.0	3063.5	2619.7
October	1723.3	1486.1	458.8	371.6	2182.1	1857.7	258.7	225.0	2440.8	2082.7
November	1811.5	1566.9	482.2	391.8	2293.7	1958.7	107.8	93.7	2401.5	2052.4
December	1782.3	1595.3	474.7	399.0	2257.0	1994.3	103.5	90.0	2360.5	2084.3
TOTAL:	25,907.6	22.408.2	6899.1	5627.0	32,806.7	28.035.2	3096.4	2692.4	35,903.1	30,727.6

1. Bozeman landfill service area includes the City of Bozeman and 4½-mile surrounding jurisdictional area as well as all other portions of Gallatin County not included in the Logan and West Yellowstone/Hebgen Basin Refuse Disposal Districts. The 1983 estimate of service area population is 34,171.

2. Gallatin County Refuse District Number One consists of the legally formed refuse district which includes the incorporated communities of Belgrade, Manhattan and Three Forks and the unincorporated communities of Amsterdam, Church Hill, Logan, Trident and Willow Creek. The 1983 estimate of refuse district population is 10,275.

3. West Yellowstone/Hebgen Basin Solid Waste District consists of the legally formed refuse district which includes the incorporated community of West Yellowstone and its surrounding area. Quantities also include wastes generated at Gallatin National Forest and National Park Service facilities in the area. The 1983 estimate of Refuse District population is 991.

1983 Processable Waste Quantities

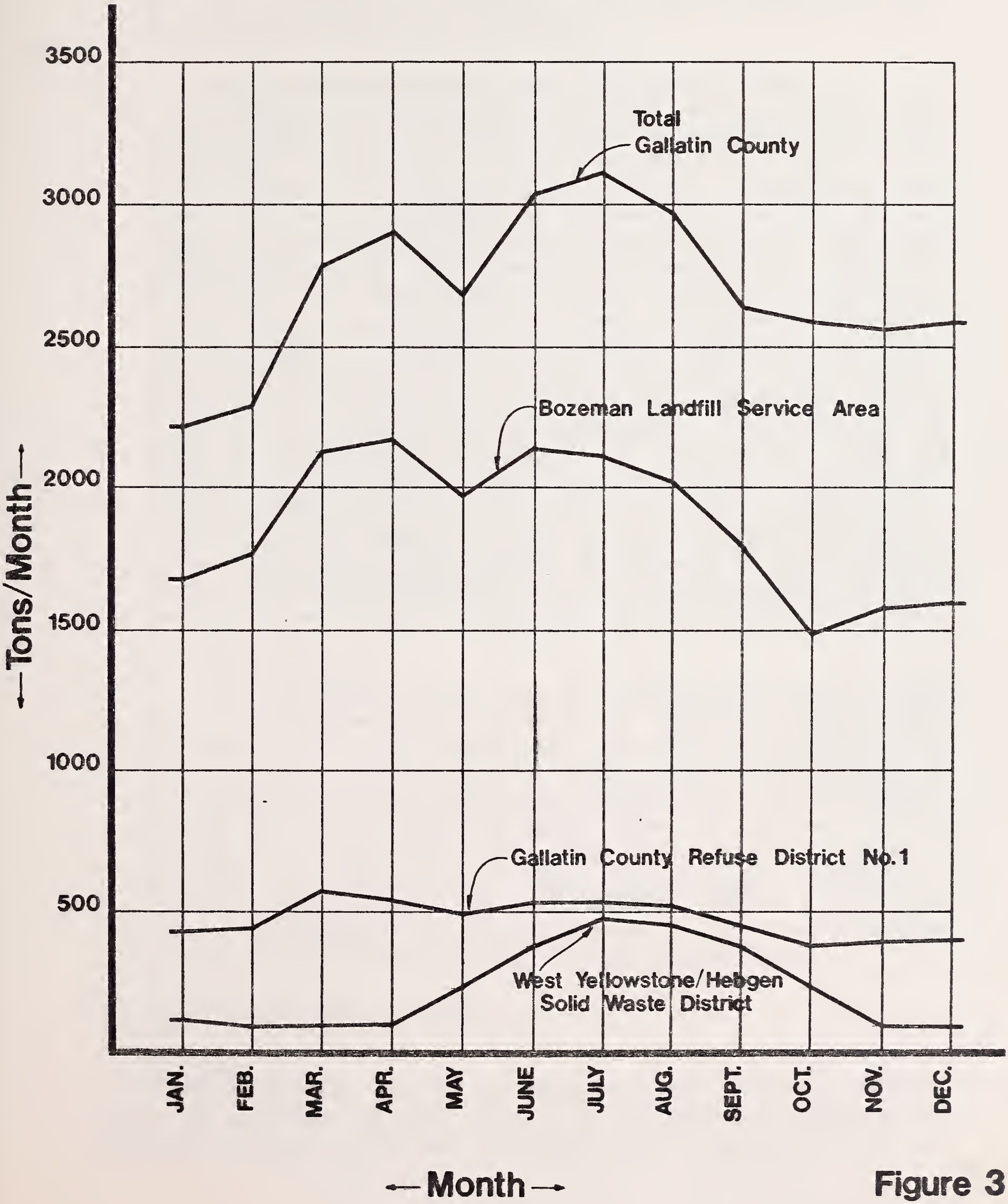


Figure 3

is estimated that by the year 2000, approximately 10,190 tons of solid waste will be generated and disposed of each year within the Refuse District. About 81 percent, or 8,311 tons of the total waste quantity will be available for processing at a refuse-to-energy facility. The year 2000 totals represent a 48 percent increase over current estimates of solid waste quantities.

c. West Yellowstone/Hebgen Basin Solid Waste District

Projecting year 2000 quantities of solid waste for the West Yellowstone/Hebgen Basin Solid Waste District is extremely difficult due to the many scenarios for future development that exist for the area. However, it is assumed that the number of permanent residents in the area will continue to increase as it has over the last decade. It is likely that the major increase in future solid waste quantities will result from increases in commercial and tourism-related wastes. As visitor usage of Park facilities is restructured, more commercial establishments and public campground development may be needed to compensate for limited facilities in the Park. Based on this assumption, a one percent per year increase in commercial and tourism-related wastes is expected for the area. By the year 2000 it is anticipated that approximately 3,854 tons of solid wastes per year will be transported via the transfer station and disposed of at the Class III landfill site. Processable wastes will account for 3,276 tons of this total. These projected quantities represent a 25 percent increase over current waste quantity estimates. It should be noted that the possible development at the Ski Yellowstone resort was not included in the year 2000 projections of solid waste quantities due to the uncertainty of that facility at this time.

d. Gallatin County

It is estimated that by the year 2000, 52,258 tons of solid waste will be generated by residents and visitors to Gallatin County. About 44,639 tons of these wastes are expected to be potentially processable at a refuse-to-energy facility. These totals account for a 45 percent increase in solid waste volumes over current estimates. Overall per capita waste generation rates are expected to drop slightly but should still remain near the statewide average. A breakdown of projections of monthly solid waste quantities for Gallatin County is contained in Table IV-2. Figure 4 graphically depicts the projected solid waste quantities for the three major geographic areas of Gallatin County through the year 2000.

C. NON-PROCESSABLE WASTES

1. General

Although various portions of Gallatin County generate different types and quantities of solid waste, the processable (residential and commercial) portion of the total wastes has similar composition character-

TABLE IV-2

YEAR 2000 PROJECTED SOLID WASTE QUANTITIES FOR GALLATIN COUNTY

Month	Bozeman Landfill Service Area[1]		Gallatin Co. Refuse Dist. No. One[2]		Subtotal		W. Yellowstone/ Hebgen Basin District[3]		Total	
	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons	Total Tons	Process. Tons
January	2761.1	2481.5	736.7	621.7	3497.8	3103.2	174.8	148.6	3672.6	3251.8
February	2866.1	2605.3	764.2	652.2	3630.3	3257.5	154.7	131.5	3785.0	3389.0
March	3487.0	3154.9	930.4	823.7	4417.4	3978.6	157.6	134.0	4575.0	4112.6
April	3661.6	3193.7	976.3	799.6	4637.9	3993.3	159.0	135.1	4796.9	4128.4
May	3398.5	2900.7	906.9	726.7	4305.4	3627.4	306.4	260.4	4611.8	3887.8
June	3803.1	3141.1	1013.8	786.5	4816.9	3927.6	510.8	434.2	5327.7	4361.8
July	3772.3	3099.3	1005.8	776.5	4778.1	3875.8	647.0	550.0	5425.1	4425.8
August	3555.1	2970.5	947.7	744.3	4502.8	3714.8	612.9	521.0	5115.7	4235.8
September	3066.4	2648.8	817.2	663.0	3883.6	3311.8	510.8	434.2	4394.4	3746.0
October	2541.9	2192.0	677.7	548.9	3219.6	2740.9	306.4	260.4	3526.0	3001.3
November	2672.0	2311.2	712.2	578.7	3384.2	2889.9	159.0	135.1	3543.2	3025.0
December	2628.9	2353.1	701.1	589.3	3330.0	2942.4	154.7	131.5	3484.7	3073.9
TOTAL:	38,214.0	33.052.1	10,190.0	8311.1	48,404.0	41,363.2	3854.1	3276.0	52,258.1	44,639.2

1. Bozeman landfill service area includes the City of Bozeman and 4½-mile surrounding jurisdictional area as well as all other portions of Gallatin County not included in the Logan and West Yellowstone/Hebgen Basin Refuse Disposal Districts. The population of the Bozeman landfill service area in the year 2000 is projected to be 50,403.

2. Gallatin County Refuse District Number One consists of the legally formed refuse district which includes the incorporated communities of Belgrade, Manhattan and Three Forks and the unincorporated communities of Amsterdam, Church Hill, Logan, Trident and Willow Creek. The population of the Gallatin County Refuse District in the year 2000 is projected to be 15,180.

3. West Yellowstone/Hebgen Basin Solid Waste District consists of the legally formed refuse district which includes the incorporated community of West Yellowstone and its surrounding area. Quantities also include wastes generated at Gallatin National Forest and National Park Service facilities in the area. The population of the West Yellowstone/Hebgen Basin Solid Waste District in the year 2000 is projected to be 1,552.

Future Waste Quantities

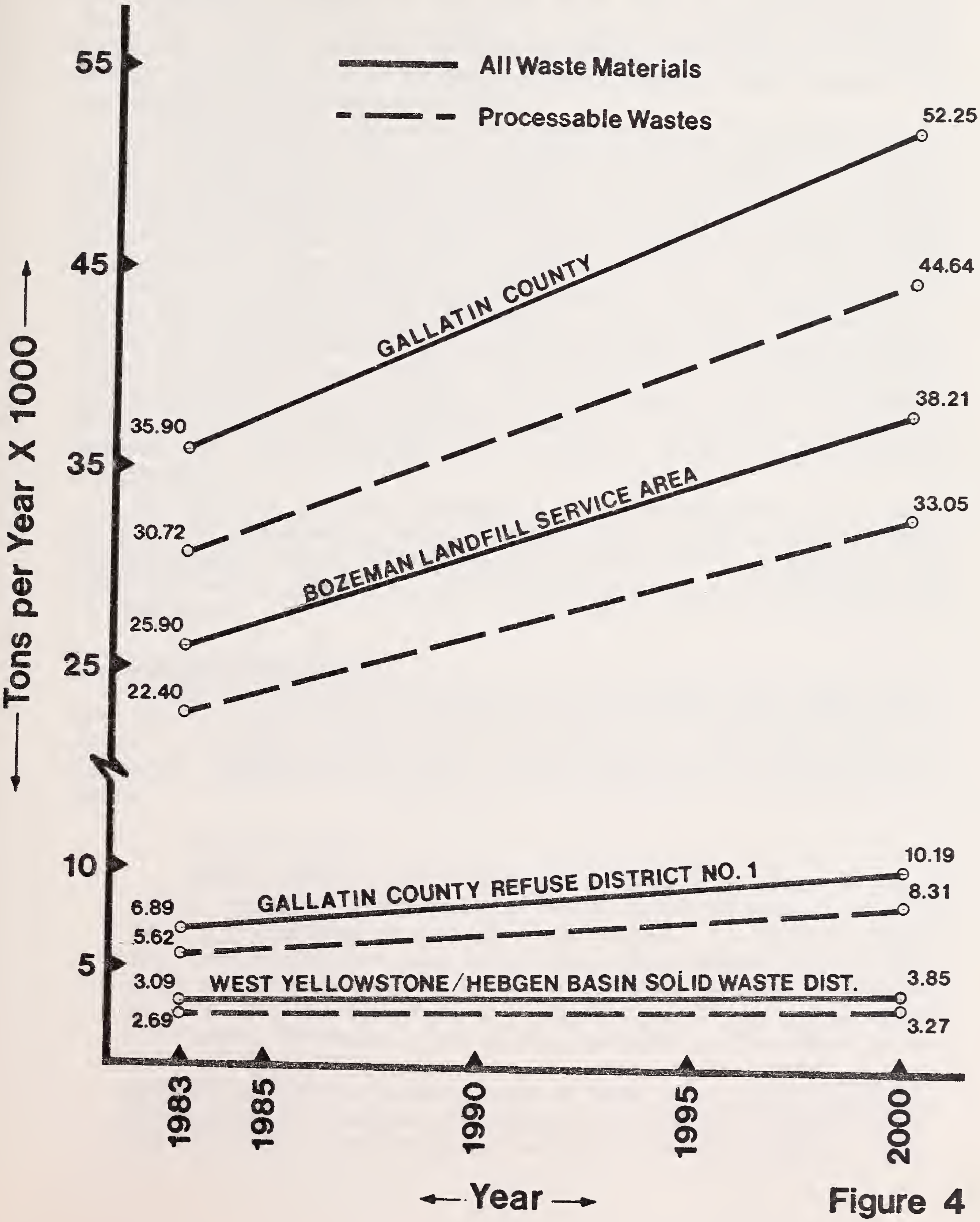


Figure 4

istics and is generated in about the same per capita quantities throughout the state. These wastes are estimated to comprise approximately 90 percent of the total waste stream. The remaining 10 percent, or the non-processable wastes, vary considerably from area to area in the state and are responsible for many of the local solid waste management problems since most require special handling and disposal procedures. Regardless of whether or not a resource recovery program is implemented in Gallatin County, provisions and/or handling facilities must be made available for the remaining non-processable wastes.

Non-processable wastes may be classified as non-hazardous or hazardous. During May, 1980 the federal government through the Environmental Protection Agency (EPA) published waste classification, handling and disposal guidelines which categorized solid waste into non-hazardous and hazardous wastes. The State of Montana generally classifies wastes according to the same guidelines established by EPA. Under the current regulations, all wastes categorized as hazardous are considered Group I wastes by the State and must be disposed of at a Class I disposal site. The State further classifies all decomposable wastes, excluding hazardous wastes, as Group II and requires their disposal at a conventional landfill. According to State regulations, all other materials such as construction debris, wood wastes and inert materials are classified as Group III materials and can be disposed of in a Class III disposal site (demolition and fill site).

The following narrative contains a brief identification of the major types of non-processable wastes generated within Gallatin County. These non-processable wastes will be further classified into non-hazardous and hazardous waste types, and typical handling and disposal procedures will be summarized.

2. Non-Hazardous Wastes

During the one-week surveillances at the Bozeman and Logan landfills, several types of non-hazardous wastes were identified. These included: 1) bulky materials; 2) dead animals; 3) used tires; and 4) wastewater treatment plant wastes. A brief discussion of each waste type follows.

a. Bulky Materials

Bulky wastes consist primarily of numerous types of wood wastes; demolition debris materials (rock, brick, concrete and earth fill); and discarded appliances (white goods). According to State guidelines, these inert materials are non-water soluble and are classified as Group III wastes. These materials are suitable for disposal at Class III sites; however, no licensed Class III site exists within the County. Therefore, most of these materials are deposited at the Class II sites at Bozeman and Logan, where separate areas at each site are set aside for specific types of bulky items. Both landfills in the County levy charges for disposal of construction debris materials and bulky wastes ranging from $2.00 per cubic yard at Logan

to $2.50 per cubic yard plus the vehicle fee at Bozeman. The West Yellowstone/Hebgen Basin Solid Waste District also accepts Group III wastes and maintains a separate landfill area for such wastes.

b. Dead Animals

The number of dead animals, both domestic agricultural animals and game animals, varies throughout the year. Animal losses may occur during calving and lambing season when weather conditions are critical to many newborn animals. Hunting season also produces numerous instances of carcass abandonment. State law prohibits the placing of all or any part of a dead animal in any water body, road, street, alley, lot or field. It is also unlawful to place all or part of a dead animal within one mile of the residence of any person unless it is burned or buried at least two feet underground. Dead animals are classified as a Group II waste and may be disposed of at a Class II landfill site if special procedures are followed. These special procedures include supervised placement in a segregated pit that will receive at least two feet of cover the same day the dead animal is deposited. Charges for the disposal of dead animals at the Bozeman landfill are based upon animal weight and range from $5.00 to $7.50. The Logan landfill charges a set fee of $5.00 per animal for disposal at the site.

c. Used Tires

Significant quantities of waste tires are generated within Gallatin County each year. According to State law, used vehicle tires are classified as Group III wastes and may be disposed of at either Class II or Class III disposal sites. The common method of tire disposal in the county is burial; however, this presents a unique problem since buried tires commonly work up to the surface unless properly positioned in the landfill. During the course of the landfill surveillances, several truckloads of used tires were deposited at county landfills.

d. Treatment Plant Wastes

Treated waste materials from the Bozeman wastewater treatment plant such as kitchen fats and solids and surface skimmings are commonly transported to the landfill for disposal. These wastes are classified as Group II wastes and may be deposited at the Bozeman landfill operated by the City. The wastes are confined to a separate dumping area and covered after disposal is completed for the day.

3. Hazardous Wastes

a. Background

Many wastes produced by agriculture, industry, hospitals and government agencies may be hazardous and may require special precautions during transport, hauling and disposal. The EPA estimates that within the United States, only ten percent of the hazardous waste generated annually is managed in an environmentally safe manner. The remainder is handled in a fashion which could potentially threaten human health and the environment.

The Environmental Protection Agency is responsible for the safe management of hazardous wastes. In May of 1980, this agency released a revised set of guidelines pertaining to hazardous waste materials. The regulations included criteria for the determination of hazardous solid wastes and hazardous waste generators; rules for transporting and disposing of the materials; and a comprehensive listing of hazardous wastes. Any solid waste which exhibits any of the characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, and toxicity) is subject to the revised EPA regulations. These guidelines have been revised on several occasions since the original publication date.

These guidelines determined a level of hazardous waste generation for individual generators that is most effectively managed by the agency. Any individual who accumulates, produces or disposed of a waste classified by the EPA as hazardous at a rate greater than 1,000 kilograms per month (2,200 pounds per month) is subject to the EPA guidelines for hazardous waste management. (This standard does not apply to farmers or ranchers.) Generators of 1,000 kg/month or less of hazardous waste may dispose of the material at an on-site facility or must ensure delivery of the material to an off-site treatment, storage or disposal facility licensed by the state to manage municipal or industrial solid waste. In addition, special regulations apply to individuals or operations which generate more than one kilogram per month of wastes categorized by the EPA as "Acute Hazardous".

The Environmental Protection Agency guidelines for hazardous waste management provide the basis for the State of Montana's hazardous waste policies. It should be noted that the Solid Waste Management Bureau of the Montana Department of Health and Environmental Sciences has the primary responsibility for the safe management of hazardous waste materials in the state. Wastes classified as hazardous by the State are the same as those classified by the EPA as hazardous. Hazardous waste generators and disposal facilities are required to notify the State regarding the type, quantity and composition of the waste material being handled, and may be required to keep pertinent records regarding the generation, transport and disposal of the hazardous waste. In addition, transporters of hazardous waste materials and hazardous waste disposal facilities must

be licensed by the State, and must operate in a manner consistent with State and federal guidelines.

The following narrative identifies the major generators of hazardous wastes in Gallatin County and discusses the current disposal practices for each. In addition to these major generators, many other establishments produce some small quantities of hazardous waste material. Individually, these firms do not meet the EPA/State criteria for hazardous waste generators; however, collectively these operations may produce significant quantities of hazardous waste materials. These "generic" types of generators will also be briefly discussed in the following paragraphs.

b. Major Generators

McFarland Cascade (Idaho Pole Division). This operation, which is located in the northeastern portion of Bozeman, is the largest single generator of hazardous waste materials in Gallatin County. The operation uses pentachlorophenol during the pressure treatment process for wooden poles. According to the most recent report filed with the EPA and the Solid Waste Management Bureau (SWMB), the plant generated approximately 21,050 pounds of hazardous wastes through plant operations during 1982. These waste materials are temporarily stored on-site in waste drums before receiving periodic shipment to the hazardous waste disposal facility in Arlington, Oregon. The Plant Superintendent estimated that total waste generation for 1983 will be at or slightly below the 1982 levels due to a slight dropoff in business.

Allen Bradley Company (Bozeman Plant). This plant, which is located on the south side of Bozeman, is an electronics manufacturing operation. Hazardous waste materials are utilized in the manufacture of printed circuits and in metal plating processes. The hazardous waste materials consist primarily of solvents (acetone, trichloroethane and trichloroethylene), heavy metal sludges with copper and lead constituents, and chromic acid solutions. During 1982, the Bozeman plant generated approximately 10,500 pounds of waste materials. These wastes are stored on-site and transported several times each year to Arlington for final disposal. The Processes Manager for the plant estimates that between 7,000 and 8,000 pounds of waste materials will be generated at the plant during 1983.

c. Other Generators

Gasoline Wholesalers and Bulk Plants. These facilities periodically generate quantities of lead wastes through the storage of large quantities of gasoline. Lead concentrates accumulate on the bottom of the large storage tanks and are periodically removed during scheduled tank cleanings. These wastes are collected and transported to out-of-state disposal facilities.

Montana State University. Montana State University generates small quantities of many hazardous waste materials through research activities conducted by many University departments. Waste materials generally are temporarily stored at facilities on campus. This policy is under review at this time.

Pesticide Applicators. Due to the agricultural nature of much of Gallatin County, significant quantities of excess pesticides and pesticide containers are generated each year. Currently in Gallatin County, the Montana Department of Agriculture, Environmental Management Division has licensed and certified 49 pesticide applicators. Metal pesticide containers are most often triple-rinsed and returned to pesticide dealers or deposited in licensed Class I or Class II landfills. Combustible containers may be deposited in licensed Class I or Class II landfills or incinerated at licensed disposal facilities.

Hospitals and Clinics. Special wastes generated at hospitals or medical clinics are generally of two types; pathological or bacteriological. Pathological wastes, which include tissues, are generally incinerated at on-site facilities or transported to other hospitals equipped with incineration facilities. Ash resulting from the incineration process is collected and landfilled. Bacteriological wastes, however, receive sterilization procedures and are ultimately landfilled. Some wastes generated by medical facilities are hazardous, such as radioactive wastes, and require special handling and disposal procedures. These procedures are subject to EPA regulations for transport, handling and disposal. All wastes which are not hazardous are collected once per week by Convenience Disposal Company.

PART FIVE

RECYCLING FEASIBILITY ANALYSIS

PART FIVE

RECYCLING FEASIBILITY ANALYSIS

A. GENERAL

The primary objective of this section of the study is to identify and evaluate existing and potential markets for secondary recoverable materials in the solid waste generated in Gallatin County. The potential for implementing a solid waste recycling program is directly dependent upon markets for the recoverable materials. Revenue from the recoverable materials must be obtained to offset the costs of collecting and separating the wastes in most cases. If revenues for the recoverable materials cannot be obtained, other methods of disposal will be more economical.

Historically and at the present time, the markets for recoverable materials have shown significant fluctuation. The fluctuations may be attributed to a number of outside forces. Among these are 1) supply and demand for specific materials; 2) strikes in virgin material industries; 3) governmental influences through tax or price incentives; 4) foreign purchases; and 5) transportation costs. In recent years, markets for recoverable materials have become more numerous and market prices have experienced an upward trend similar to that of other raw commodities. Although future prices are extremely difficult or impossible to predict, it would be reasonable to expect this trend to continue. In addition to the economic factors, environmental, technological, political and sociological forces are emphasizing recycling programs as a desirable and practical alternative to conventional solid waste disposal. The extreme fluctuations in price and quantities are lessened in magnitude and frequency as the market for recoverable materials increases. When prices are adequate enough to make recycling attractive, many individual waste generators practice recycling. When the market drops below a certain economic level, these recycling materials become solid waste.

B. TYPES AND QUANTITIES OF RECOVERABLE MATERIALS

An important factor that must be determined prior to the evaluation of the feasibility of recycling solid wastes is the quantity and composition of wastes generated in the study area. Generally there are two types of recoverable materials found in processable solid wastes: 1) secondary materials that can be reused, such as newsprint, corrugated paper (cardboard) glass, and metal containers; and 2) those materials which can be used as a fuel source to generate steam, electricity and/or heat. The analysis included in this chapter summarizes the feasibility of recovering those secondary materials generated in the county. The

complete analysis evaluating the feasibility of utilizing solid waste as an energy source will be discussed at length in Part Six.

In most instances, the recoverable secondary materials that are practical to recycle are limited to ferrous and non-ferrous metals, separated newsprint and cardboard, and glass. In some instances, other materials such as clothing, rubber and wood products are economically recoverable. However, these instances are uncommon and have not been addressed in this study.

The estimated quantities of recoverable secondary materials generated in the study area are depicted in Table V-1. The quantities of materials depicted are based on the waste generation information developed in Part Four of this report and the waste composition data that was determined applicable from the state-wide solid waste study conducted in 1976. As the table indicates, approximately 2,428 and 400 tons of recoverable ferrous and non-ferrous metals, respectively, are generated in the county annually. Also, 7,682 and 3,073 tons of paper and corrugated, respectively, are generated and potentially recoverable annually. If market conditions are favorable, it is anticipated that a majority of this material could be recovered economically and effectively. Quantities of recoverable materials are projected to increase approximately 45 percent by the year 2000.

C. MARKET ANALYSIS FOR SECONDARY MATERIALS

The basic objective of the product identification and marketing portion of this study was to identify potential buyers for the products which could conceivably be separated from solid wastes within Gallatin County. Based upon research and the landfill inventories conducted for this study, it is apparent that a variety of products could possibly be recovered from the solid waste generated in the county. In order to explore the market potential of the alternative products more efficiently, these products were grouped into several major categories: 1) ferrous metals; 2) non-ferrous metals: 3) glass; and 4) paper products. The first task in this analysis was to identify the major processes used in the recovery of the material and the uses the material may serve. Local markets, other Montana markets and national or regional markets were subsequently addressed for each of the major categories.

1. Recovery Processes

a. Ferrous Metals

Ferrous metals may be recovered from solid waste materials by two general processes which include chemical processing and remelting. Chemical processing may be utilized to extract tin or copper constituents from ferrous materials. De-tinning is an industrial process which recovers tin from the tin-plated steel. The usual source of such materials are tin-plated steel cans rejected in the can manufacturing process or cans recovered from domestic solid waste.

TABLE V-1

SUMMARY OF PROCESSABLE WASTE COMPOSITION
FOR GALLATIN COUNTY

(Tons Per Year)

Characteristic	Average Percentage of Processable Waste[1]	Estimated Current Quantity	Year 2000 Projected Quantity
Combustibles:			
Paper	25.0	7681.9	11,159.8
Cardboard	10.0	3072.8	4463.9
Other	42.0	12,905.6	18,748.5
Subtotal	77.0	23,660.3	34,372.2
Non-Combustibles:			
Ferrous	7.9	2427.5	3526.5
Non-Ferrous	1.3	399.5	580.3
Glass	5.7	1751.5	2544.4
Other	8.1	2488.8	3615.8
Subtotal	23.0	7067.3	10,267.0
TOTAL:	100%	30,727.6	44,639.2

1 Source: "Population, Employment and Waste Generation Report" prepared for the State of Montana Department of Health and Environmental Sciences, 1976.

This process generally yields about seven pounds of tin from each ton of scrap cans. Copper precipitation involves the use of sulfuric acid to leach out copper from low grade ores or ferrous scrap, such as reclaimed steel cans. This process is one of the few economically feasible methods of recovering copper from low grade ores.

In addition, steel scrap may be remelted in steel furnaces and iron foundries and used to produce new steel products. The main source of remelting material, steel cans, may not be a desirable raw material due to the low density of the scrap and non-ferrous contaminants. Other ferrous scrap such as white goods, appliances, automobiles, and similar materials are denser and are better suited for the remelting process. Steel can scrap may also be used to produce ferro-alloys when the iron is combined with controlled quantities of other elements. The resulting material is then used as an additive in melts for alloy steel and castings.

b. Non-Ferrous Metals

Although non-ferrous metals (comprised primarily of aluminum) represent less than one percent (by weight) of the municipal solid waste, once separated these materials become extremely valuable and numerous markets exist. The primary non-ferrous metal recovered at the present time is aluminum. Current technology has developed two processes which may be utilized to isolate and remove aluminum after the general metal waste has been shredded and ferrous metals have been magnetically removed. The first procedure utilizes chemicals to create a dense media to float aluminum on the surface and thus separate it from other materials. The recovered aluminum is a mixture of aluminum alloys together with other light metals. The market value of this material is rather low due to the relative poor quality of the aluminum material isolated by this process.

In the second procedure, the aluminum fraction found primarily in beverage cans may be isolated utilizing mechanical devices. Many of these devices, however, have not been proven successful to date. This material is a single alloy and has a relatively high market value. The aluminum recovered by both processes and other scrap aluminum is remelted and cast directly into ingots for use in making new cans and other products.

Mixed non-ferrous metals account for a small portion of the total non-ferrous metals that can be recovered from solid waste. This portion of the waste consists of small amounts of copper, lead, zinc, brass and other metals. Each of these metals is valuable by itself, but extensive processing is required to recover individual non-ferrous metals. Currently, the recovery of these metals by processing is not economically feasible.

c. Glass

Certain types of glass which are contained in municipal solid waste may be recovered, remelted, and used in the manufacture of

new glass products. Most glass manufacturers readily accept the scrap glass, or cullet, because its use reduces fuel consumption and aids the melting process by liquifying at lower temperatures than new materials. Color and purity requirements established by glass manufacturers limit the recovery of glass to some extent. The only reliable method of insuring the quality of the recovered glass is by manual sorting, an expensive and time-consuming process. Unsorted crushed glass scrap has been utilized in some areas as an aggregate in the production of asphalt and other building materials.

d. Paper Products

Waste paper products may be recovered by several different methods which include: 1) direct recovery by the paper industry; 2) manual segregation of selected papers by consumers; 3) mechanical processing of municipal waste to recover fiber material; and 4) conversion to usable forms of energy by processing the paper along with other post-consumer wastes. Recovered paper is primarily used for the manufacture of building products and for repulping. The operations that use waste papers as a raw material are extremely concerned about levels of contaminants such as plastics, metals, and oils, which have serious effects on some manufacturing processes. It is very probable that some recycled papers could not be acceptable for uses such as food packing because of public health concerns.

In general there are three major types of waste paper that are easily recoverable. These types include:

1) Used containers, both solid fiber and corrugated (cardboard);
2) News, which includes newspapers and special types of newsprint;
3) Mixed papers, primarily mill wrappers, computer cards and printouts, book stock, and magazine papers.

2. Secondary Materials Markets

For the purposes of this report, inquiries were made to three levels of secondary materials markets: national, state, and local outlets. Several national and state industrial and trade associations were contacted and potential buyers of these materials were identified from each association's membership. As the list of potential buyers increased, specific inquiries were formulated regarding the required material specifications, the capacity each potential buyer might have for recovered materials, and the pricing structure associated with each of the potential products. Included herein is a summary of the market investigations which were conducted to determine the feasibility of recovering secondary materials from the solid wastes generated within Gallatin County. Prices included in the following tables reflect Fall, 1983 commodity markets.

a. Ferrous Metal Markets

On the national level, some interest was shown by Midwestern markets in purchasing ferrous materials which could potentially be recovered from solid waste generated in the study area. Utilization of these markets is not currently profitable due to the long haul distances and the high freight and handling costs required to transport the material to the nearest plant locations.

Markets for secondary ferrous materials within Montana consist primarily of scrap metal dealers, and those contacted expressed considerable interest in purchasing recovered ferrous materials. Local and area markets that have indicated an interest in purchasing certain types of ferrous scrap metal include:

American Recycling (Bozeman)	Cast/Scrap Iron ($25/ton) Steel Beverage Cans ($.06/lb.)
Bozeman Recycling Center	Steel Beverage Cans ($.04-.08/lb.)
Butte Recycling Center	Steel Beverage Cans ($.10/lb.)
Carl Weissman & Sons, Inc. (Bozeman - Butte)	Cast/Scrap Iron ($20-30/ton) Steel Beverage Cans ($.04-.10/lb.)
Pacific Steel/Hides/Furs/Recycling (Bozeman)	Cast/Scrap Iron ($20-50/ton) Steel Beverage Cans ($.08/lb.)

b. Non-Ferrous Metal Markets

In regard to potential markets for the recoverable non-ferrous metals generated within the study area, it was determined that definite national markets exist for these materials. Several firms from the Pacific Northwest expressed interest in these materials; however, high transportation and handling charges effectively prevent the use of the markets at this time.

Numerous state and local outlets exist for recovered non-ferrous metals, primarily because each metal is relatively valuable. Aluminum, copper, brass, and to some extent lead are most often purchased by scrap metal dealers. The price paid for each metal is dependent upon the quantity and the amount of contaminants each recovered material contains. The most favorable local and area markets are summarized as follows:

American Recycling (Bozeman)	Aluminum Cans ($.30/lb) Aluminum Scrap ($.26-.28/lb) Brass ($.22-.40/lb) Copper ($.45-.50/lb) Auto Batteries - Lead ($.60/ea) Auto Radiators - Brass ($.28/lb)

Bozeman Recycling Center	Aluminum Cans ($.30/lb) Aluminum Scrap ($.03-.15/lb) Brass (Not accepted) Copper (Not accepted) Auto Batteries - Lead ($.50/ea)
Butte Recycling Center	Aluminum Cans & Scrap ($.25/lb) Brass ($.30-.40/lb) Copper ($.35-.40/lb) Auto Batteries - Lead ($.75/ea)
Carl Weissman & Sons, Inc. (Bozeman - Butte)	Aluminum Cans ($.27-.30/lb) Aluminum Scrap ($.17-.30/lb) Brass ($.20-.50/lb) Copper ($.35-.65/lb) Auto Batteries - Lead ($.75-1.00/ea) Auto Radiators - Brass ($.25-.30/lb)
Pacific Steel/Hide/Furs/Recycling (Bozeman)	Aluminum Cans ($.30/lb) Aluminum Scrap ($.20/lb) Brass ($.22-.32/lb) Copper ($.35-.40/lb) Auto Batteries - Lead ($.50/ea) Auto Radiators - Brass ($.25/lb)

Local efforts to recycle non-ferrous metals generated within Gallatin County are primarily individual voluntary actions. Many individuals in the study area regularly collect aluminum beverage containers and return them to local recycling centers. Individuals in outlying areas of the county typically accumulate aluminum containers until it is convenient to utilize one of several recycling outlets in the county.

c. Glass Markets

An investigation into the location of glass container manufacturing plants indicated that very few glass manufacturing industries are close enough to Montana to be considered potential markets. The Owens-Illinois Corporation operates two glass container plants in the Pacific Northwest which accept large quantities of recovered glass. Again, it is not feasible to utilize this market at this time due to high transport and handling costs.

The most favorable local markets exist with the recycling centers and beverage distributors located in Bozeman and Butte. These outlets accept only specific types of beverage bottles and glass. The following area markets appear to be the most favorable outlets for certain types of glass that may be recovered from within the county:

Bozeman Recycling Center	Selected beverage bottles ($.25/case)
Butte Recycling Center	Selected beverage bottles
($.24/case)	
	Other select glass (½¢/lb)
Mountain Country Distributing (Bozeman)	Coors bottles only ($1/case) Refillable pop bottles ($.10/ea)

d. Paper Markets

Numerous outlets for recovered waste papers, including newsprint, corrugated and other types of mixed papers, exist within the region and the state of Montana. Firms located in eastern Washington, Utah and in southeastern Idaho expressed interest in purchasing certain recovered materials from the study area. The paper market fluctuates a great deal and at the present time it is not economical to use these regional markets because of transportation costs.

Numerous outlets for waste paper within the State of Montana may be utilized effectively if market conditions are favorable. An insulation manufacturer located in Great Falls purchases and uses newsprint throughout the year. During the past year, the price being paid for newsprint has increased somewhat, a reflection of the trend being experienced by the building industry. Bozeman and Butte recycling centers accept newsprint and other types of waste paper and provide the most favorable local outlet for recovered paper. The following listing summarizes the most favorable outlets for waste paper materials potentially recoverable from waste generated within the study area:

Bozeman Recycling Center	Newsprint ($20/ton) Computer cards ($.05/lb) Computer printout ($.03/lb)
Butte Recycling Center	Newsprint ($40/ton) Cardboard ($10/ton) Computer cards ($.05/lb) Computer printout ($.03/lb)
Robinson Insulation (Great Falls)	Newsprint ($40/ton delivered)
Clayville Insulation (Burley, Idaho)	Newsprint ($40-60/ton delivered)

In most cases, market prices dictate that the material must be delivered to the plant location. Market prices for newsprint and corrugated papers may also be significantly, higher if large quantities of clean materials are available and if the density of the waste paper is increased through preliminary processing or baling.

Several large grocery stores in Bozeman and one in Belgrade are currently using baling equipment to recover corrugated paper containers. The bales are periodically collected by wholesale grocery suppliers and transported either to recycling outlets in Montana or to recycling plants in the Pacific Northwest.

Efforts to recycle newsprint within Gallatin County are generally voluntary, and no formal recycling program is known to exist. Conversations with the insulation manufacturer in Great Falls indicate that newspapers are collected by the Boy Scouts from the Bozeman area several times each year. Local response to this fund-raising activity has been quite favorable in past years.

D. SUMMARY OF RECYCLING FEASIBILITY

Included in the following narrative is a summary of current recycling efforts and a discussion of the potential for economically recovering and marketing secondary materials found in the study area's solid waste stream.

1. Ferrous Metals

Due to the small quantity of ferrous materials (2,428 tons per year) generated annually within the study area and the long distances between the study area and Midwestern consumers, utilization of regional markets is prohibitive at this time. This fact makes the utilization of local or area markets the most feasible alternative.

Currently, efforts to recover ferrous metals within the study area consist of voluntary recycling on an individual basis. Ferrous materials, primarily scrap metal and junk vehicles, may be transported to several outlets in the county. A copper refining plant in Butte, operated by the Atlantic Richfield Company, employed a copper precipitation process which utilized ferrous materials; however, facility operations have been suspended indefinitely.

2. Non-Ferrous Metals

Regional markets for non-ferrous metals exist in the Midwest and on the West Coast; however, the high transportation costs associated with shipping non-ferrous metals from the study area to these regional markets make their utilization not economically feasible at this time for small generators.

However, numerous state and local markets exist for non-ferrous materials generated within the study area, primarily because of the value of many of these metals. Although only 400 tons of non-ferrous metals are generated in the study are annually, the favorable price structures of the non-ferrous metals markets provide the largest incentive for recovery of these metals.

Currently, voluntary recycling of non-ferrous metals, primarily aluminum beverage containers, is practiced within the study area. Many individuals regularly collect beverage containers and return them to

beverage distributors or scrap metal dealers located in Bozeman or Butte. Private organizations or clubs have undoubtedly collected these materials for fund-raising projects within the study area.

3. Glass

Currently, the potential for the recovery of most types of waste glass is relatively low. Although regional markets in the Pacific Northwest expressed interest in obtaining waste glass from the study area, available quantities of glass and the market prices do not offset transportation charges. Utilization of area markets for recovered bottle glass is the most practical recycling alternative. Glass recycling within the study area consists solely of voluntary efforts. Selected beverage bottles are purchased by area recycling centers or beverage distributors in Bozeman and Butte.

4. Paper Products

Although national and regional markets do exist for some paper products, it appears most feasible in the future to utilize the waste paper markets within the state due to high costs of transporting the materials to regional outlets. As previously mentioned, several operations within Montana utilize newsprint in the manufacture of cellulose fiber insulation. Presently, the only known organized effort to recycle newsprint within the study area is undertaken periodically each year by the Boy Scouts as a fund-raising activity. Prices in the paper market are dependent upon the building industry and are extremely variable. It is anticipated that recycling of newsprint or corrugated by individuals or groups would be initiated if market conditions were favorable.

At the present time, resource recovery options for the study area appear limited. Due to the relatively small quantities of recoverable materials generated annually within the study area, the distance to regional markets, and in many cases the present market pricing structure, development of an extensive resource recovery program is not seen as feasible for the study area. Markets for non-ferrous metals, primarily aluminum, have consistently improved in recent years and implementation of a recycling program for these recoverable materials would appear to be the most feasible option.

PART SIX

PRELIMINARY RESOURCE RECOVERY ANALYSIS

PART SIX

PRELIMINARY RESOURCE RECOVERY

A. RESOURCE RECOVERY TECHNOLOGY ASSESSMENT

1. Applicable Systems

a. General

The following five energy recovery methods were investigated as representative of current resource recovery technology: modular incineration, waterwall incineration, refractory wall incineration, refuse derived fuel, and pyrolysis. The first three types produce thermal energy directly, and the last two produce a fuel for use in other combustion applications. Each is briefly described below together with its advantages and disadvantages.

b. Modular Incineration

Modular incinerators are relatively small units, ranging in size from 8 to 120 tons of solid waste per day. The units are fabricated in a manufacturing plant, transported to the job site and then assembled on site. Several units can be used in parallel to provide the desired plant capacity. The maximum plant size constructed to date is about 340 tons per day.

Modular incinerators are usually two chamber batch feed units designed to handle unprocessed solid waste and frequently are used for part time operation. The waste is usually dumped on a tipping floor and then loaded into a feed hopper by a small front-end loader called a skid-steer loader. Bulky items such as refrigerators and engine blocks cannot be incinerated and must be removed from the solid waste. A hydraulic ram then pushes the waste into the primary combustion chamber where it burns in a starved air environment. The primary chamber converts most of the fuel value in the solid waste to a hot combustible gas which is conveyed into a secondary combustion chamber. The ash in the primary combustion chamber is pushed through the chamber by the ram action until the ash leaves the chamber and is cooled in a water quench basin.

The hot combustible gas is burned in the secondary combustion chamber and then directed through a separate heat recovery boiler to produce steam or hot water. After passing through the heat recovery boiler the gas is conveyed to a stack where it is discharged to the atmosphere. As a result of this controlled combustion, the exhaust gases

emitted through the stack are low in particulates. The incineration residue is about 40 percent by weight of the input and has a density of about 1200 pounds per cubic yard.

The system efficiency defined as the energy content of steam produced divided by the total energy input is about 60 percent.

Modular incineration has some significant advantages. It has traditionally been the most cost-effective technology available for small capacity facilities, with a lower unit cost than large capacity systems. Where higher tonnages of solid waste are processed, multiple units can be used. However, at capacities above 150 TPD other technologies are price competitive. The use of multiple units allows redundancy, which in turn permits maintenance without completely stopping operation. Since modular incinerators are pre-engineered from standard designs, with extensive shop fabrication, costs are relatively low, and construction and start-up times are relatively short (periods of one year have been achieved). Materials handling is generally simple, mostly manual, which avoids some operational problems. The waste volume reduction is significant, about 90 percent with a corresponding reduction in landfill requirements. The design and operation of the units are oriented towards reducing particulate and gaseous emissions, in many instances meeting air quality criteria without expensive air pollution control equipment.

Some of the disadvantages of modular incineration are described below. If the units operate on a frequent cycle, the cyclic on/off operation, slagging, and corrosion contribute to the breakdown of the refractory material used on the walls of many modern units. Combustion control requires supplementary fuel which, if required too often, defeats the fuel saving purpose of the incinerator. Since each ram load of waste to the incinerator is on an intermittent basis, the steam quantity is more variable than for constant feed units. In cases where pollution control equipment is required to meet air quality standards, the cost advantage may be lost. The operating life of the incinerator is 15 years or less, a significant factor to consider in life-cycle costs in comparison to other type incinerators.

c. Waterwall Incineration

Waterwall incinerators devise their name because the walls of the furnace in the burning zone are lined with tubes filled with water. The waterwalls remove heat from the furnace rapidly thus permitting full combustion of the waste with minimum excess air.

Waterwall incinerators are usually erected on site and are relatively large combustion units. The units minimum capacity are about 100 tons per day of solid waste, and capacities below 200 tons per day are not economically attractive. Waterwall incinerators are usually designed to handle processed solid waste and usually operate on a continuous basis.

Solid waste is dumped into a pit which usually has enough storage capacity for continuous seven-day-a-week operation. Overhead cranes mix the solid waste and load it into the incinerator feed hoppers. Mechanical grates move the waste through the furnace where drying, ignition, and burnout take place. The interior walls of the furnace are constructed of closely spaced tubes carrying water which absorbs heat as the water is circulated to the boiler. Flue gases are cleaned by electrostatic precipitators before being emitted through the stack to the atmosphere. The combustion residue (ash) is removed from the furnace, quenched, conveyed to a storage contained, and/or dumped into a truck for haul to a disposal site. Waste volume and weight reduction are comparable to modular incineration. The system efficiency defined as the energy content of steam produced divided by the total energy input is about 70 percent. At least two units are generally used so that when maintenance is required, one unit can remain in service.

An advantage of waterwall incinerators is their ability to operate over a service life of more than 20 years. Although in small capacities, they usually have a higher capital cost than modular units, they may be competitive on a life cycle basis. The pit storage and crane for mixing solid waste improves operation and fuel homogeneity. The use of grates and absence of shredders, air classifiers, and conveyors simplifies and improves operation compared to RDF systems.

Although efficient and reliable, waterwall incinerators require air pollution control equipment which increases the cost and provides another piece of equipment which increase the probability of mechanical failures compared to modular incinerators.

d. Refractory Wall Incinerators

Most refractory wall incinerators bear some resemblance to waterwall incinerators, except for the absence of the waterwall and its corresponding features. Refractory wall incinerators are erected on site, and they use refractory material in the combustion chamber, with heat recovery occurring in another part of the unit. Refractory wall incinerators are proven technology, having been used effectively for many years. The solid waste is stored and delivered to the furnace in the same manner as in waterwalls. Likewise, combustion takes place on a mechanical grate which moves the solid waste through the furnace. The action of the grate mixes the solid waste and provides maximum exposure to air for combustion. Gases from the chamber are drawn through a heat recovery boiler to generate hot water or steam. The hot flue gases are usually cleaned by medium energy scrubbers or electrostatic precipitators prior to exhausting to the stacks. Residue is quenched prior to loading on trucks. The system efficiency defined as the energy content of steam produced divided by the total energy input is approximately 65 percent.

e. Refuse Derived Fuel (RDF)

Refuse derived fuel (RDF) is the processed combustible portion of solid waste. It is produced by size reduction of the waste and automated removal of most of the non-combustible material such as ferrous, glass, aluminum, dirt, etc.

RDF was originally conceived to be a supplemental fuel for co-firing with coal in boilers but most recent facilities have been designed to produce a fuel to be burned in 100 percent RDF fired units (dedicated facility). Three basic types of RDF are produced: coarse, which has been shredded once and has most of the heavy and non-combustible components removed; densified, which is the coarse RDF which has been shredded again,compressed or pelletized; and fine, which is the coarse material which has been processed further to a powder and is used for co-firing with pulverized coal. The nature of the RDF production process lends itself to recovery of other materials such as glass and ferrous scrap. The first step in RDF processing is usually a flail mill, which opens bags and partially breaks up the materials; then shredding in a hammermill, which reduces the size of the solid waste. Size reduction is followed by magnetic separation which removes the ferrous scrap. In some facilities further separation is accomplished with a trommel (a rotary screen with diminishing slot sizes). The solid waste may be sent to a second stage shredder which reduces the solid waste to a smaller size.SEcond stage shredding is usually followed by air classification to further remove non-combustibles. The remaining light fraction of the solid waste constitutes the RDF. Some facilities include systems for separation of glass and aluminum which have not been very successful. The advantages of RDF are that it can be stored and transported for burning elsewhere.

Boilers must be designed or retrofitted to burn RDF and in some instances other modifications, such as additional grates are required. Boiler modifications may include RDF nozzles, combustion air modifications, air spouts, and distributors. Production and combustion of RDF is classified as a commercially operational method.

The system efficiency of the RDF process, defined as the energy in the steam that could be produced by the RDF divided by the total energy input is approximately 50 percent based on a boiler efficiency of 72 percent.

Although RDF is commercially available and technically feasible, it may not be economical to produce or use, because it may not be marketable or competitive with other fuels. Existing boilers usually require retrofitting before they can accept RDF, and sometimes grates must be added for more complete combustion. The shredding, air classification, and other handling systems required are subject to operational problems and failures. The glass content of the RDF may cause boiler slagging. Unit processes for removing glass and aluminum have not been sufficiently developed. Nationwide studies indicate that RDF facilities have the highest failure rate of all energy recovery methods.

f. Pyrolysis

Pyrolysis is the destructive distillation of the organic fraction of solid waste. It takes place when the organic fraction is exposed to heat in the absence or near absence of oxygen. The process can produce either gases or liquids which may be burned in equipment not suited for solid fuel. The reactor itself may be a fluidized bed, rotary kiln, or stationary chamber. The operating temperature and pressure determines whether the product is liquid or gaseous. Use of RDF feedstock assures free and uniform feeding, avoids bridging of material within the reactor, and increases heat transfer efficiency. The fuel produced must be cleaned of contaminants by using scrubbers, electrostatic precipitators, condensers,liquid cyclone decanters, or other means, depending on the nature of the fuel.

A potential advantage of pyrolysis is that it produces a gas or oil fuel substitute which can be stored and burned at another location. Preparation of the coarse RDF feedstock may make ferrous scrap recovery cost-effective. The main disadvantage of pyrolysis is insufficient operating experience and relatively high costs. The process is in many respects still developmental. The fuel produced must be cleaned of contaminants before use, which increases the cost. Pyrolysis systems have not been very successful. The system efficiency defined as the energy content of steam produced from the fuel product divided by the total energy input will range from 25 to 60 percent.

g. Summary

Since the processable solid waste generated in the County is projected to range from 80 tons per calendar day in 1983 to 120 tons per calendar day in 2000, and the best energy (in the form of steam) customer appears to be Montana State University, modular incinerators appear to be the most appropriate technology for the County at this time.

2. Success/Failure Assessment

Available literature and reports were analyzed to determine the underlying reasons for success or failure of resource recovery facilities across the United States. Case-specific conditions were found to determine which of the many factors involved have the greatest impact. This underscored the importance of considering all potential factors during planning and design. Although some factors resisted categorization, most related to one or more of the three following categories: supply/market, technical viability, and economics/cost. A brief discussion of the potential factors affecting each category follows.

a. Supply/Market

* Uncertainties regarding the quantity and/or composition of available solid waste. Facilities receiving appreciably less

waste than they were designed for cannot process it economically. Oversizing is prevented by analyzing data specific to the wasteshed during planning and design. Such analysis makes possible realistic throughput projections and may identify additional supplies available to supplement expected low yield periods.

* Uncertainties regarding the marketability of recovered products (energy and/or materials). Some facilities find they cannot sell the recovered products. Thoughtful pre-analysis will determine market continuity and stability, or lack of it. For example, ferrous scrap is purchased, not sold; that is, a ready and willing buyer for ferrous scrap cannot be taken for granted.

* Uncertainties regarding the selling price of the recovered product. Several facilities cannot sell their products at the projected prices. Since prices vary with the competitive market structure, conscientious analysis is required to determine realistic levels of output and price for probable, but varying conditions.

* Fixed price. Fixing the price of a recovered product can have serious effects when the costs of production increase or the price of the replaced product decreases. The price should be dynamic, set both to keep pace with costs and to remain competitive.

* The cost of procurement and marketing. Municipalities failing to understand the nature of production enterprises engage in lengthy and complicated procurement and marketing exercises whose high cost is added to the tipping fee. If the municipality were to seek the lowest cost from a responsible and responsive bidder the process would be shorter, cost less, and add little to the tipping fee.

* Underpricing the resource recovery technology. Past mistakes are sometimes perpetuated in designs lacking required process and materials handling steps. Adding these steps at the onset will raise the capital cost, but will make the plants more reliable, the revenues more stable, and the operation and maintenance costs lower. Consideration could be given to designing for lower product specifications and to selling the intermediate products to specialists for further processing.

b. Technical Viability

* Difficulties regarding design and technical problems. Poor designs fail to take into account the variety of wastes in terms of materials handling and separation requirements. The resulting lack of appropriate process steps may create operational problems and increase cost when the facilities require retrofitting to resolve the problems. There is no substitute for a competent and experienced design.

* Uncertainties regarding the quantity and composition of solid waste. These uncertainties parallel uncertainties regarding the ability of the equipment and processes to meet the specifications, which can result in increased costs and failure to produce the required products.These uncertainties are avoided by analyzing wasteshed-specific data and keeping the facility design as simple as possible, that is, lowering the product specifications and concentrating on easily obtainable and marketable products.

* Untried or unproven technology. Many technical problems must be overcome before a new technology becomes operational. These result in uncertainties and can cause problems related to cost, product, and marketing. Except for adequately funded demonstration projects, such technologies should be avoided.

c. Economics/Cost

* Optimistic, incomplete, or inadequate projections. For the reasons discussed, actual capital, operation, and maintenance costs of a facility are sometimes higher than projected or revenues are lower and more variable than expected. Potentially affecting factors must be considered and completely dealt with during planning and design to avoid these problems.

* Uncertainty with regards to environmental regulations. Environmental regulations can have a significant impact on costs. The cost of compliance with existing and future regulations could make a facility economically unfeasible.

* Inadequate identification, quantification, and planning regarding the risks involved. Production enterprises i.e., processing of raw material to produce marketable materials, are by nature risky. Conscientious analysis will identify and quantify the risks so that initial and contingency funding can be provided along with risk sharing agreements between participants.

* Lower costs of alternative disposal methods. Landfilling costs less in many cases because of availability of land and failure to meet environmental regulations. Current enforcement trends may eliminate this situation as more landfills are brought into compliance. Recognition of availability of landfills which are competitive with resource recovery systems will help avoid the risk of failure for this reason.

* Unforeseen inflation. Unforeseen high rates of inflation, have adversely affected some facilities. Prices and fees should be tied to inflation to insure continued project viability.

* Uncertainty as to the quantity and composition of the waste. Failure to receive the expected quantity or quality of solid waste could result in inability to economically process the waste. Adequate analysis of the waste stream is the answer to such uncertainties.

* Disregard of significant cost components. For example, solid waste collection and transportation is approximately 80 percent of the total solid waste management system cost. If a resource recovery facility would significantly reduce haul costs, and this reduction were disregarded, the potential haul cost savings would not be considered as they should. Capital cost is another significant cost component. A tendency may develop to size the facility for a tonnage higher than available or economical to transport in order to take advantage of economy of scale. However, this situation results in excessive costs. Modular design allows economy of scale for smaller tonnages in a large number of cities without incurring excessive capital costs.

d. Other Factors

* Time. The requirement to have an operable solution to a solid waste problem within a very short time frame invites shortcuts, uninformed decisions, and poor design. The temptation to dictate unrealistic time schedules must be resisted. The problem becomes even worse if the facility fails.

* Sponsor commitment. Other things being equal, the greater the commitment of the sponsoring entity or entities, the better the chances of success for the facility.

* Political and social factors. Recovery operations present as many political and social problems as technical. The importance of effectively dealing with committee meetings, public

hearings, voting, and other political processes cannot be overstated.

In summary, many factors potentially contribute to the success or failure of resource recovery facilities. Because of case-specific conditions, all must be given thorough consideration, complete study, and workable resolutions must be developed to assure successful implementation.

B. MARKET ANALYSIS OF POTENTIAL ENERGY USERS

1. General

To determine the market situations that have the most potential for utilizing solid waste as an energy source, the consultant initially determined the energy users located in the study area that have the highest energy demand. Through the necessary research and investigations, it was determined that four facilities in the county have energy demands that may be conducive to a waste-to-energy situation. These include: 1) the central steam plant at Montana State University in Bozeman; 2) AE Montana, Inc., an ethanol distillation facility located near Amsterdam; 3) Ideal Basic Industry's cement processing plant located near Trident; and 4) Cyprus Industrial Minerals Company's talc plant located near Three Forks.

For each of the four potential market situations, the consultant conducted an on-site interview with the individuals responsible for operation and management. During each interview, the following information was obtained: 1) quantity and seasonal variation of energy demand; 2) delivery conditions of energy; 3) existing facilities related to steam generation, electricity, etc.; 4) projected energy demands and delivery conditions; and 5) present and projected production and fuel prices. In addition to this information, the consultant also reviewed each site to identify possible locations and potential constraints of locating a resource recovery facility. Based on the investigations conducted herein, the following narrative summarizes each market situation.

2. Potential Market Situations Investigated

a. MSU Steam Plant

Currently most of the buildings located on the MSU campus are heated by a central steam generation and distribution system. The central plant that provides the necessary steam is equipped with three natural gas-fired boilers. Two of the boilers are rated at 50,000 lbs/hr and one at 100,000 lbs/hr. They were installed in 1959, 1960 and 1969, respectively. One of the 50,000 lbs/hr boilers is also equipped to fire fuel oil on a standby basis.

Figure 5 summarizes the typical steam demand by month for the MSU facility (average of last five years of records) as well as the potential steam that may be marketed from 100 ton per day (TPD) and 40 TPD resource recovery facilities. A 100 TPD plant would be capable of handling the wastes currently being disposed of at the Bozeman landfill; a 40 TPD plant would be capable of meeting MSU's minimum steam demand. As can be noticed in this figure, the steam demand at the university exceeds the quantity of steam that is available from the solid waste generated in the Bozeman landfill service area.

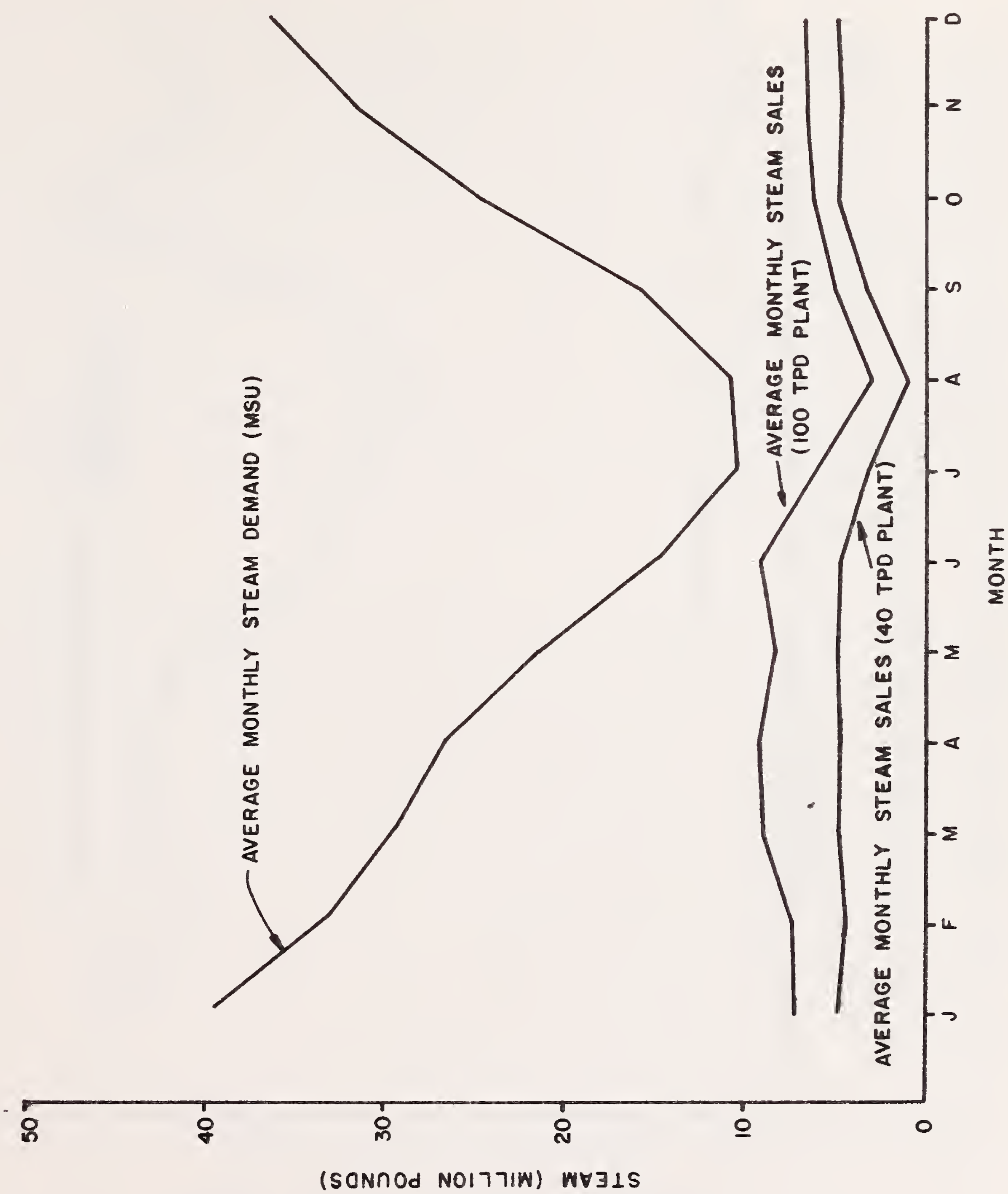
In addition to the steam demand, the consultant also determined the electricity requirements of the entire university complex. Figure 6 depicts the electrical requirement of the university for a typical year (the average of the last three years of records). In addition, this figure shows the potential electricity that could be marketed from two alternate resource recovery sized facilities. As indicated on Figure 6, the electrical demand of the university far exceeds the electricity that could be generated from all the solid wastes that would be generated in Gallatin County in the year 2000.

b. Cyprus Talc Plant

The Cyprus Industrial Minerals Company operates a talc plant located one-half mile south of Three Forks. The plant, which is one of the largest in the nation of its kind, primarily processes talc minerals and converts them to various talc-related products. The plant primarily utilizes natural gas to fire the various components of the operation. The two plant components that utilize most of the natural gas consumed are the dryers and the main processing and grinding facilities. The dryers, which are fluid-bed dryers fired at approximately 350°F, typically consume approximately 50,000 MCF of natural gas annually. Plant personnel have indicated that this use could increase in the future, depending on the talc market and possible plant improvements. In addition, the main grinding and processing facility requires approximately 30,000 lbs/hr of steam. This usually requires up to 300,000 MCF of natural gas per year to provide heat. Currently, improvements are being constructed to modify the heating requirements of the grinding and processing facility. The extent of energy reductions as a result of these improvements will not be fully known until the improvements are completed and the facility is operational.

c. Ideal Basic Industries

Ideal Basic Industries operates a plant at Trident that produces portland cement. The plant has a capacity of approximately 330,000 tons of cement annually, and utilizes most of its energy in the kiln operation. The kiln is primarily fired with 10,000 Btu coal, which is transported from a mine in Wyoming. The coal is supplemented with natural gas and petroleum coke purchased from the Exxon refinery in Billings. The plant typically utilizes approximately 200 tons per day of



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STEAM DEMAND AND SALES

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Helena · Montana

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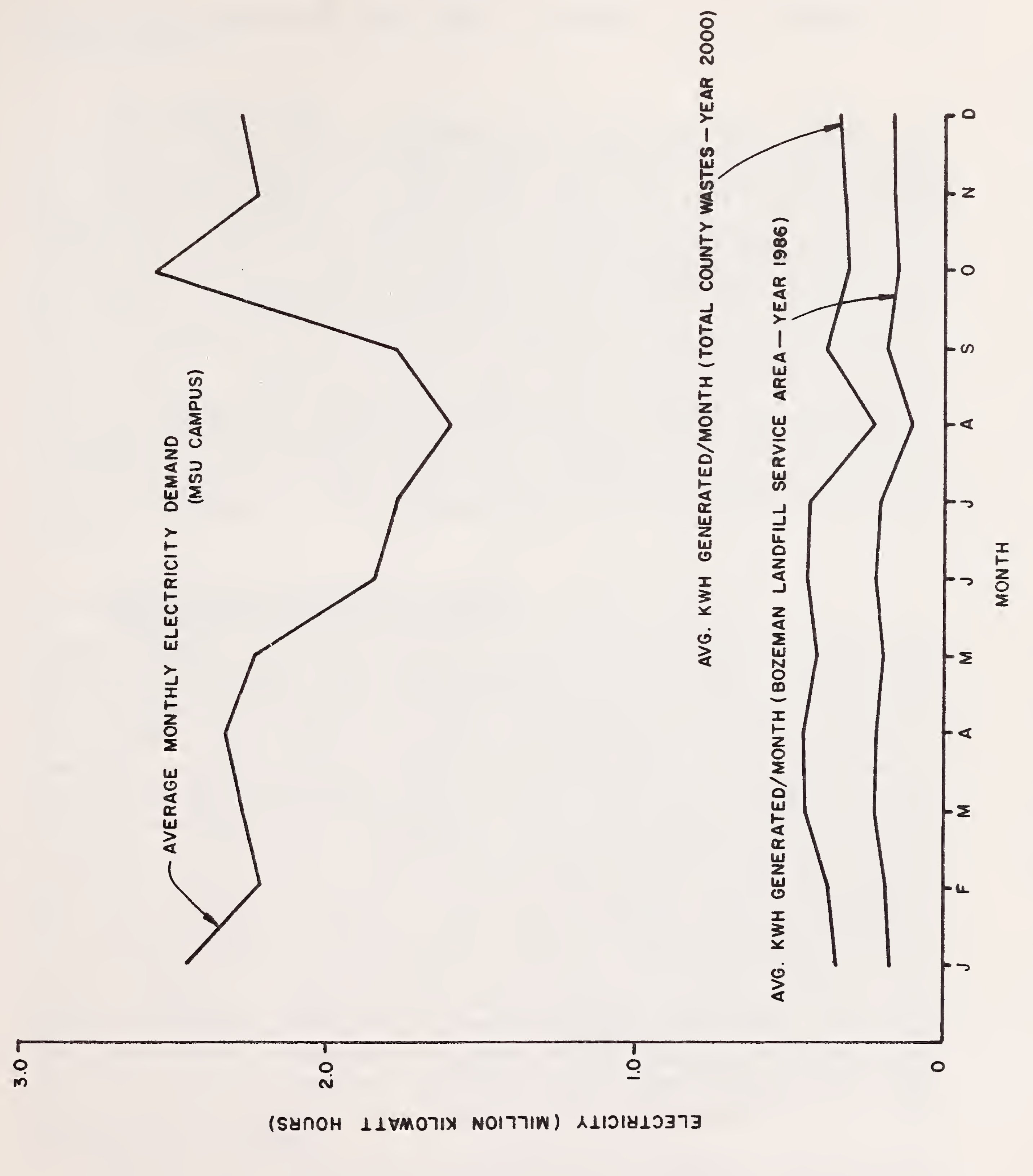
Kansas City · Missouri

FIGURE 5



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ELECTRICITY DEMAND
AND SALES

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FIGURE 6

coal, which represents more than 75 percent of the facility's total energy demand.

d. AE Montana, Inc.

AE Montana, Inc. operates an ethanol plant located near Amsterdam. The plant converts barley to anhydrous ethanol. Currently, the plant produces 2,800 gallons per day. The plant utilizes natural gas dryers to reduce the moisture content of the barley distillers wet grains from 60 percent to approximately 10 percent. The dryers consume an average of approximately 25,000 MCF of natural gas per year. In addition to the dryers, the plant also utilizes 3,500 lbs/hr. of steam in the distillation process. The steam at the facility is generated by a 165 hp Kewanee stoker-fired boiler. This boiler utilizes approximately 6 tons of coal per day. Plant personnel are in the process of modifying the facility's capabilities, and plant management has indicated that the steam demand may increase by 60 to 70 percent. Currently, the plant also utilizes coke purchased from the Exxon refinery in Billings to meet approximately 20 to 25 percent of its fuel needs.

3. Summary of Market Investigations

Based on the analysis of the four potential energy markets investigated herein, it was determined by the consultant that the MSU steam plant and the Cyprus Talc facility appear to be the most promising and thus warrant an in-depth economic analysis. The primary reason for this decision is two-fold: 1) these two facilities' energy demands exceed the energy that is available from the solid waste generated in their respective geographic areas; and 2) these two facilities' energy delivery conditions are compatible with the energy conditions that could be produced and delivered by a solid waste-to-energy resource recovery facility. In the case of the ethanol plant located near Amsterdam, the primary drawback is the lack of energy demand compared to the energy available from the solid waste. Correspondingly, the primarily drawback of the Trident cement plant involves the extra expense required to process the solid waste to meet the plant's energy delivery conditions. This would involve installing shredding, air classifying and metals separating equipment at the resource recovery facility. Other potential market situations could utilize "mass burn" techniques that are usually more feasible for small facilities such as are considered in Montana.

Based on the conclusions drawn from the analysis conducted and summarized herein, the consultant has conducted a preliminary site selection and economic facility analysis for the MSU and Cyprus alternatives. This analysis is included in the following text.

C. PRELIMINARY SITE SELECTION ANALYSIS

1. General

As indicated in the preceding chapter, there are two energy market situations within the county that should be evaluated in further detail: 1) the MSU central steam plant; and 2) the Cyprus talc plant. For these two situations, a brief resource recovery facility siting analysis was conducted. It should be noted that the siting analysis included herein is quite preliminary in nature and that it is the intent of this project to conduct a substantially more detailed siting analysis on the recommended alternative during the second phase of this project (if applicable).

2. MSU Steam Plant Alternative

During the initial stages of this project, the consultant discussed possible sites for a resource recovery facility with representatives of the MSU Physical Plant. As a result of these discussions, three alternate sites were identified as potentially viable. The locations of these sites are depicted on Figure 7. It should be noted that these three sites were somewhat randomly selected; additional sites should probably be evaluated if the project proceeds into Phase Two.

a. Alternate Site "A"

This alternate site is located immediately south of the existing central steam plant. The site would be located where 18 storage sheds currently exist. The primary advantages of this location would include the minimal length of steam lines that would have to be constructed to connect to the existing steam plant; and the close proximity to the existing steam plant which would allow for good coordination and possible savings in personnel requirements between the existing steam plant and the new resource recovery plant. The primary disadvantage of Site "A" includes: 1) the additional cost that may be necessary to relocate the 32,000 square feet of storage; 2) the lack of available room to comfortably locate the necessary resource recovery building and on-site facilities; and 3) the proximity of the site to existing campus facilities and buildings.

b. Alternate Site "B"

This site would be located adjacent to Lincoln Road and southwest of Roskie Hall, and is currently utilized for intramural activities such as softball, football and soccer. As indicated on Figure 7, approximately 800 linear feet of steam line would have to be constructed to connect to the existing system at a manhole located just east of Roskie Hall. The primary advantages of this site are the abundance of land and the lack of buildings in close proximity. The primary disadvantages are the poor soils in the area, which would probably require pilings for the building; and the need to relocate or abandon the recreational fields in the area.

POTENTIAL RESOURCE RECOVERY SITES
MSU Campus Alternatives

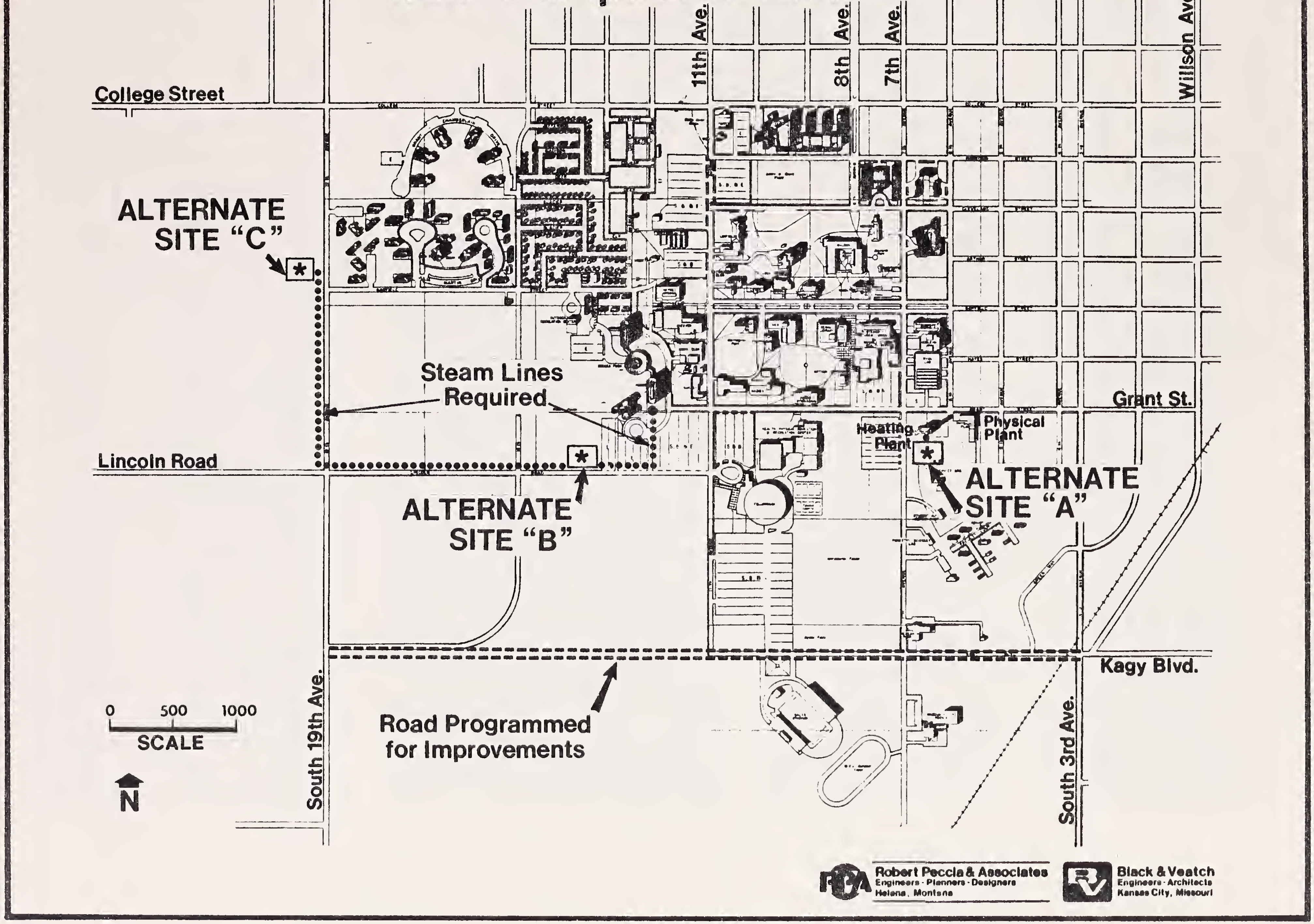


FIGURE 7

c. Alternate Site "C"

This site would be located near the intersection of South Nineteenth Avenue and Garfield Street. Currently, the area is being used for agricultural purposes in conjunction with the MSU agricultural experiment program. The primary advantages of this site are the abundance of land and the lack of conflicting land uses and buildings in close proximity. The primary disadvantage of the site is the length of steam line that would have to be constructed to connect the new facility to the existing steam system.

d. Traffic Assessment

An important criteria to be evaluated for any alternate resource recovery site is the potential impact of the added traffic volumes. Based on the landfill survey conducted by the consultant in July, 1983, it was determined that 464 vehicles utilized the landfill during a one-week period. Based on this data, it is projected that approximately 254 vehicles, or 55 percent of the total vehicles using the Bozeman landfill during that surveillance period, would utilize a resource recovery facility. It is assumed that the remaining vehicles would be transporting Group III wastes to a Class III landfill. A breakdown of these vehicle data is depicted in Table VI-1.

A review of the transportation network in the area of the three alternate sites indicates that local traffic would be impacted the least for Alternate Sites "B" and "C" since both sites are currently adjacent to major arterials (Lincoln Road and South Nineteenth Avenue). At the present, the increased local traffic resulting from locating the resource recovery facility at Alternate Site "A" would cause a greater impact than for Sites "B" and "C". However, it is felt that this impact would not be significant, since the daily traffic would only increase by approximately 42 vehicles. As shown in Figure 7, Kagy Boulevard is scheduled for improvement to South Nineteenth Avenue in the near future (according to the recently published Bozeman Transportation Plan). This improvement would aid traffic ingress and egress to all three sites; Alternate Site "A" would probably benefit the most from such an improvement.

3. Cyprus Talc Plant Alternative

For this alternative, the consultant conducted a brief review of possible sites for the resource recovery facilities. It was determined that there are numerous areas located within close proximity to the Cyprus facility that would be quite conducive for a resource recovery facility. Depending on the final siting criteria, it appears that the site could either be located on Cyprus property or primary property immediately adjacent to the plant.

Since the problems that might be associated with locating a site for this alternative appear to be minimal and since the overall economics of this alternative are unfavorable as documented in the following

TABLE VI-1

LANDFILL VEHICLE USAGE[1]
(Vehicles per Week)

Vehicle Type	Total No. of Vehicles	Vehicles Per Week: No. Vehicles to Resource Recov. Facil.	Vehicles Per Week: No. Vehicles to Class III Landfill
City Packer	25	25	0
Convenience Packer	41	41	0
Valley Packer	10	10	0
MSU Packer	5	5	0
City Open	14	1	13
Convenience Open	6	6	0
Valley Open	3	3	0
MSU Open	15	4	11
Pickups & Cars	230	106	124
Trucks	52	14	38
Contractors	57	39	18
Special	6	0	6
TOTAL:	464	254	210

1 Data based on one-week surveillance (July 25 - 30, 1983)

section, a more detailed site selection analysis was not deemed necessary and was not done. It is the consultant's recommendation, however, that if further analysis determines that this alternative should be re-evaluated, a more specific site selection analysis should be performed.

D. ECONOMIC FEASIBILITY ANALYSIS

1. General

An economic feasibility analysis was performed for the following four geographic areas of the County:

* West Yellowstone/Hebgen Basin Solid Waste District
* Gallatin County Refuse District Number One
* Bozeman Landfill Service Area
* Total Gallatin County

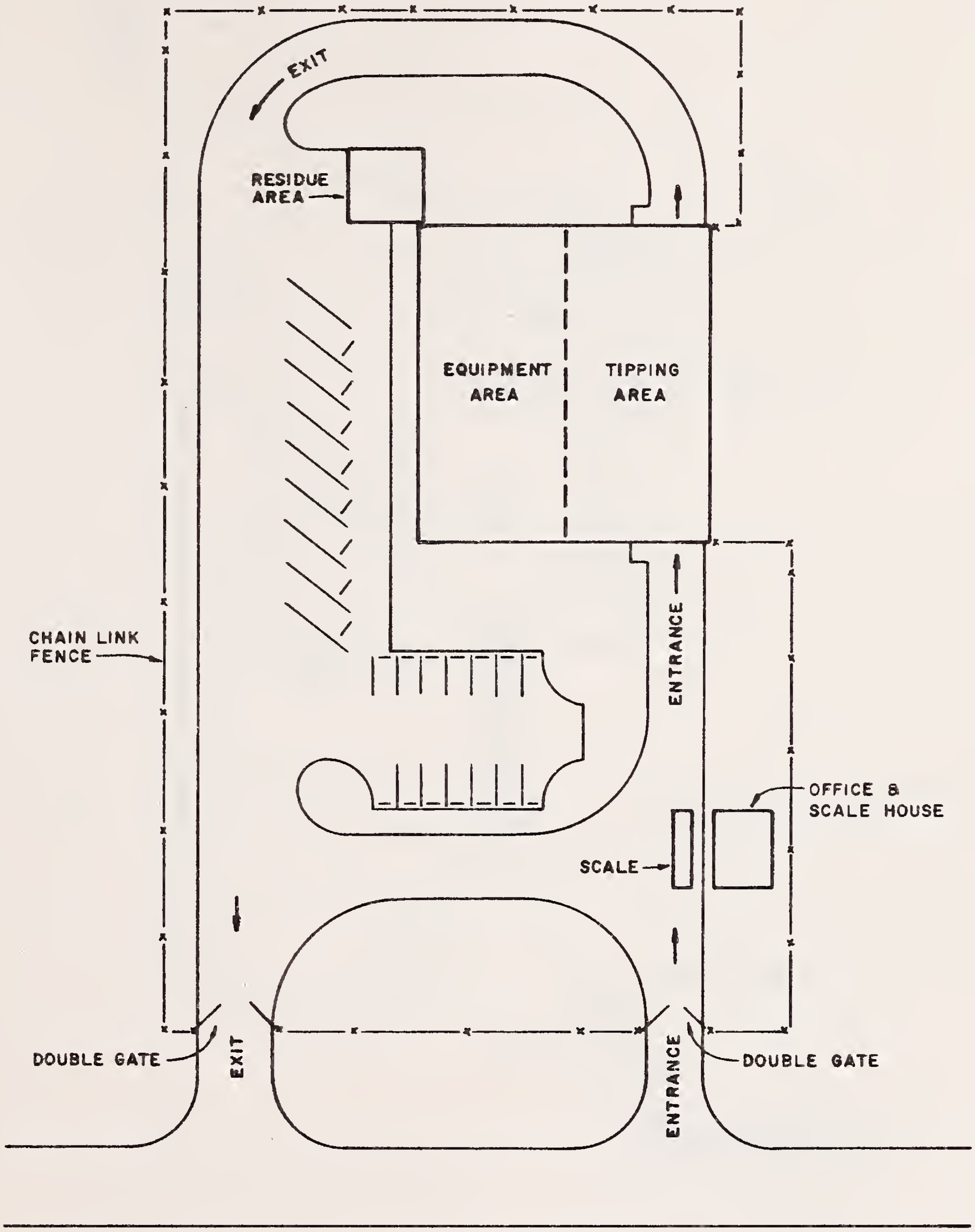
Several alternative systems were evaluated for each area. The following sections describe the economic feasibility analysis and the results. Specific detailed costs for each are included in Appendix A. A life cycle cost analysis was conducted for most alternatives. Some alternatives did not include increasing revenues over the planning period and therefore were not subjected to a life cycle cost analysis. It is assumed that the earliest date for first year operation of a resource recovery facility would be 1986 and that the planning period is 15 years (through the year 2000).

Figures 8 and 9 show two site layouts for a typical resource recovery facility. Figure 8 shows a facility with a drive-through arrangement and Figure 9 shows an arrangement with only one combined entrance and exit. Each arrangement has its advantages and disadvantages. Both arrangements should be given further consideration in the next phase of the project (if applicable) when site location becomes an important part of the overall evaluation.

2. West Yellowstone/Hebgen Basin Solid Waste District

a. Introduction

The West Yellowstone/Hebgen Basin Solid Waste District is located in the extreme southern part of Gallatin County. The present method of solid waste management consists of a transfer station and a Class III solid waste disposal site located approximately four miles north of West Yellowstone. Processable solid waste is collected and hauled to the transfer station where it is transferred into a 65-cubic-yard trailer and then hauled to the Ennis landfill, located approximately 65 miles away. Group III solid waste is hauled directly to the Class III disposal site located adjacent to the transfer station. Three alternatives were



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RESOURCE RECOVERY FACILITY
SITE LAYOUT A

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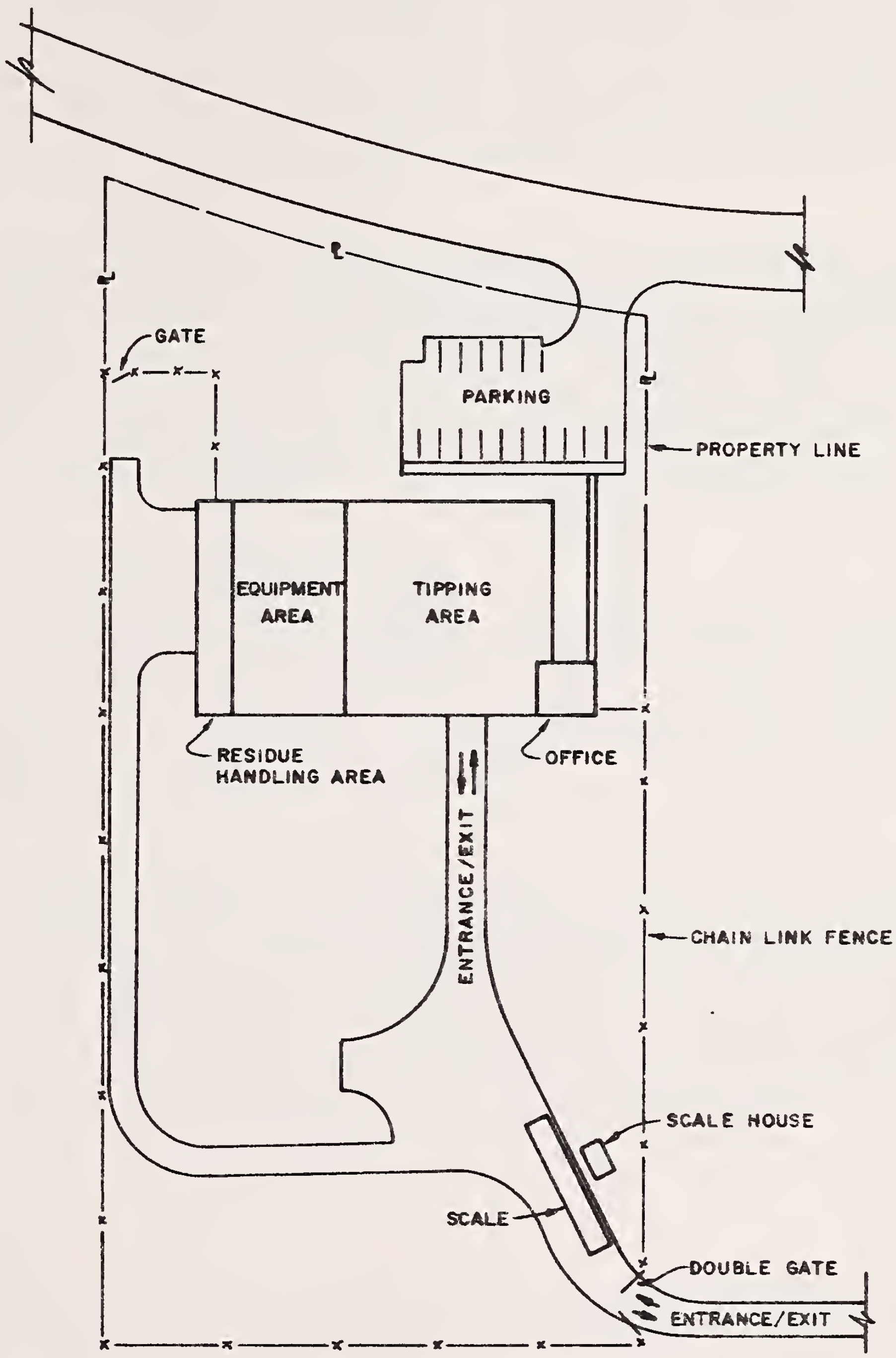
FIGURE 8



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RESOURCE RECOVERY FACILITY
SITE LAYOUT B

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Helena, Montana

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FIGURE 9

evaluated for this solid waste district: continue hauling to the Ennis Landfill; haul to the existing Bozeman Landfill; and haul to a new Bozeman Landfill. Since the collection costs and the transfer station costs are the same for all alternatives, only the transfer haul costs and disposal costs were considered. These costs are described herein.

b. Continue Landfilling at Ennis

The disposal fee at the Ennis Landfill is $14.00/ton. According to the recent bid received by the Refuse District for transporting the wastes to Ennis, the transfer haul cost is $0.34/ton-mile. The haul cost is based on one way haul distance and includes the round trip cost. Therefore, the haul cost for one ton solid waste equals: $0.34/ton-mile x 65 miles = $22.10/ton. The haul and disposal cost is therefore $22.10/ton plus $14.00/ton, or $36.10/ ton.

c. Haul to Existing Bozeman Landfill

The disposal cost at the existing Bozeman Landfill is $7.26/ton. The Bozeman Landfill is approximately 90 miles from the transfer station. Therefore, the haul cost for one ton of solid waste equals: $0.34/ton-mile x 90 miles = $30.60. The haul and disposal cost equals: $30.60/ton plus $7.26/ton, or $37.86/ton.

d. Haul to a New Bozeman Landfill

Costs in 1983 dollars for a new landfill to serve the Bozeman area are $10.82/ton and are detailed in the next section of this report. It is assumed that the new Bozeman Landfill would be located 20 miles from the City of Bozeman and in a direction that would reduce the haul distance from the West Yellowstone transfer station to the new landfill to 80 miles. The haul cost would then be: $0.34/ton-mile x 80 miles = $27.20/ton. The haul and disposal cost would therefore be $27.20/ton plus $10.82/ton, or $38.02/ton.

e. Summary

The costs for these alternatives are shown in Table VI-2. The lowest cost alternative is to continue to haul to the Ennis landfill. Since there are no expected increases in revenues such as sale of steam or electricity that would offset costs, a life cycle cost analysis was not conducted for the West Yellowstone/ Hebgen Basin Solid Waste District.

It should be recognized, however, that a modest change or changes in either the haul or disposal costs for any of the options could modify the results of this analysis to the point that any one of these three options would be the most economical. For example, the ton-mile transfer haul cost may not be the same for all three alternatives. Capital and labor costs are probably about the same for the three alternatives. Fuel, oil, tires and maintenance are probably the only significant costs that vary with distance.

TABLE VI-2

WEST YELLOWSTONE / HEBGEN BASIN SOLID WASTE DISTRICT

COST SUMMARY[1]

	Alternative Transfer Hauls from West Yellowstone with Disposal At:		
	Ennis Landfill[2] (Cost/Ton)	Existing Bozeman Landfill[3] (Cost/Ton)	New Bozeman Landfill[4] (Cost/Ton)
Haul Cost[5]	\$22.10	\$30.60	\$27.20
Disposal Cost	14.00	7.26	10.82
TOTAL:	\$36.10	\$37.86	\$38.02

1 Costs are in 1983 dollars.

2 Based on a 65-mile one-way haul distance.

3 Based on a 90-mile one-way haul distance.

4 Based on an 80-mile one-way haul distance.

5 Haul costs include the cost of the return trip.

3. Gallatin County Refuse District No. One (Logan District)

a. Introduction

The Logan Refuse District is located in the northwest portion of Gallatin County. The district includes the communities of Belgrade, Manhattan, Logan, Trident, Three Forks, Willow Creek, Churchill, and Amsterdam.

As presented in Part Two, the quantities of waste developed for purposes of this report are tabulated below:

ESTIMATED SOLID WASTE QUANTITIES
LOGAN REFUSE DISTRICT

Year	Total Tons/Year	Processable Tons/Year
1983	6,899.1	5,627.0
2000	10,190.0	8,311.1

Based on the above quantities, four alternatives for managing solid waste in the Logan Refuse District were considered. The first is continued landfilling at the existing Logan Landfill (Alternative LA). The second, (Alternative LB), includes the use of a resource recovery facility at Three Forks to generate steam and continued landfill operation at Logan for disposal of non-processable waste and for disposal of residue from the resource recovery facility. The third, (Alternative LC), is to construct a transfer station near the Logan Landfill and transfer processable solid waste to the Bozeman Landfill. The Logan Landfill would continue to operate as a Class III landfill. The fourth (Alternative LD), includes hauling all solid waste directly to the Bozeman Landfill and closing the Logan Landfill.

Detailed discussions of each of the alternatives follow.

b. Alternative LA - Continue Landfilling at Logan

This alternative assumes that all solid waste collected in the Logan district will be landfilled at the existing Logan Landfill. The solid waste generated in the district would be transported directly to the Logan Landfill. The remaining life of the landfill is estimated to exceed the 15-year planning period. The advantages of this alternative include familiarity with the operation, availability of an existing site, and very low capital cost.

Since the economics of a resource recovery facility are developed on a life cycle cost basis and compared to landfilling as a base alternative, a life cycle cost for continued landfilling at Logan was developed. The costs and their bases are described in Appendix A.

The expected cost of this alternative for 1983 is shown below:

ALTERNATIVE LA
CONTINUE LANDFILLING AT LOGAN

Haul Cost:	6,899.1 tons x $0.50/ton-mi x 10 mi	=	$ 34,500
Landfill Cost:	6,899.1 tons x $13.77/ton	=	95,000
Total Annual Cost:			$129,500
Cost per Ton			$18.77/Ton

c. Alternative LB - Resource Recovery 35 TPD (Steam Only)

This alternative was considered to evaluate the feasibility of constructing a resource recovery facility to generate steam for sale to the Cypress Industrial Minerals Company located at Three Forks. The resource recovery facility was sized for this alternative to incinerate the maximum quantity of solid waste generated within the district during any week of the year. The information provided below indicates how the facility capacity was derived.

ALTERNATIVE LB
RESOURCE RECOVERY 35 TPD (Steam Only)
FACILITY CAPACITY

Processable Solid Waste in the Logan Refuse District (Year 2000): 8,311.1 Tons
Average Week: 8,311.1 tons / 52 = 159.8 tons
Maximum Week: 159.8 tons x 1.5 = 239.7 tons
Average Day during Maximum Week = 239.7 tons / 7 days 34.2 tons
Size for 35 tons per day (TPD)

Two resource recovery alternatives were evaluated. The first one (Alternative LB1) reflects the probable project cost of the facility on the high side. Table VI-3 shows the probable capital cost and Table VI-4 shows the operation and maintenance costs for Alternative LB1. These costs were used in the computer analysis in Appendix A.

Since the cost for Alternative LB1 is considered to be on the high side, it was desirable to evaluate the alternative on a low-cost basis also. Alternative LB2 is based on a low-cost concept. The probable project cost for Alternative LB2 was reduced to $1,933,000 or $55,200 per TPD. Other cost parameters were also reduced to obtain an operation and maintenance cost of the facility of $30.00/ton. The changes in these parameters compared to Alternative LB1 are included in the printouts in Appendix A.

TABLE VI-3

ALTERNATIVE LB1 - RESOURCE RECOVERY 35 TPD (Steam Only)
PROBABLE CAPITAL COST

Item	Probable Cost (1983 Dollars) Cost	Cost/Ton/Day
Land	$ 3,600	
Incinerator Building	481,000	
Incinerators w/Energy Recovery Units	1,051,000	
Site Work	96,400	
Truck Scale	67,000	
Steam & Condensate Return Pipeline	83,000	
Direct Construction Costs:	$1,782,000	$50,900
Contingencies	178,000	
Engineering	90,000	
Construction Management	36,000	
Startup	178,000	
Legal & Financing	53,000	
Net Interest during Construction	116,000	
PROJECT COST:	$2,433,000	$69,500

TABLE VI-4
PROBABLE ANNUAL O & M COSTS

Item	Annual O & M Cost (1983 Dollars) Cost	Cost/Ton/Day
Labor	$ 243,000	$ 43.18
Electrical	5,700	1.02
Water	1,000	0.18
Sewer	600	0.11
Natural Gas	11,600	2.06
Fuel	6,500	1.15
Maintenance & Supplies	27,400	4.87
Insurance	15,000	2.67
Residue:		
Fixed Disposal Costs	6,200	1.10
Variable Disposal Costs	24,800	4.41
Fixed Haul Costs	3,500	0.62
Variable Haul Costs	2,000	.36
Subtotal:	$ 36,500	$ 6.49
Total:	$ 347,300	$ 61.73/Ton

d. Alternative LC - Transfer Station and Haul

This alternative consists of the following elements:

* A transfer station would be constructed at the Logan landfill to receive processable waste. The processable waste would then be hauled to the Bozeman landfill.

* The Logan landfill would continue to operate as a Class III landfill for the disposal of non-processable solid waste.

The transfer station would be sized to handle the maximum quantity of solid waste expected in one day in the year 2000. For the Logan Refuse District, the maximum day is estimated to be approximately 57 tons. Two transfer station concepts were evaluated: non-compaction type and compaction type. The probable capital costs and annual operation and maintenance costs for each are shown in Tables VI-5 and VI-6, respectively. The compaction type station has a lower annual cost and therefore was used to determine the estimated costs for Alternative LC. The differences in costs of compaction and non-compaction systems are so small that the choice would probably be based on other factors such as whether the conveyor bottom non-compaction trailers tend to freeze and become inoperable.

Using the costs summarized in Table VI-7, the annual cost and cost per ton for this alternative were calculated as summarized below:

ALTERNATIVE LC COST SUMMARY
TRANSFER AND HAUL TO BOZEMAN

Primary Haul Cost: 6,899.1 tons/yr x $0.50/ton-mile x 10 mi:	$34,500
Disposal of Group III type wastes: (6,899.1 tons - 5,627 tons)($6.00/ton)	7,600
Disposal of processable solid waste at the Bozeman Landfill: (5,627 tons x $7.26/ton)	40,900
Transfer station cost and haul cost:	153,300
TOTAL:	$236,300
COST/TON: ($236,300/6,899.1 tons)	$34.25

There are some disadvantages with this option, including: 1) The Bozeman Landfill has a relatively short life and increasing the amount of solid waste sent to the landfill would further reduce the expected life; 2) A new Bozeman Landfill site has not been located, and a new landfill may be located farther away than the existing landfill; 3) A new landfill would probably have higher costs than the existing Logan

TABLE VI-5

ALTERNATIVE LC - PROBABLE TRANSFER STATION COSTS
(Non-Compaction Type)

Item	Unit Cost	Units	Capital Cost	Annual Cost
CAPITAL COSTS:				
Facility				
Land	$1,500/acre	2.5 acres	$ 3,750	
Sitework	Lump Sum	- -	40,000	
Building	$45/sf	70' x 70'	220,500	
Utilities	Lump Sum	- -	15,000	
Hoppers	$13,000/ea.	1	13,000	
Engineering, Legal & Contingency	Lump Sum	20%	58,450	
Subtotal			$350,700	
Amortization (10% - 20 yrs.)				$ 41,200
Rolling Stock				
Transfer Trailer	$36,000/ea.	2	$ 72,000	
Transfer Tractor	$45,000/ea.	2	90,000	
Front-end Loader	$35,000/ea.	1	35,000	
Contingency	Lump Sum	10%	19,700	
Subtotal			$216,700	
Amortization (10% - 5 yrs.)				$ 57,200
Total Capital Cost			$567,400	
ANNUAL OPERATION & MAINTENANCE COST:				
Utilities	Lump Sum	- -		$ 3,000
Insurance	Lump Sum	- -		1,000
Tractor/Trailer O & M	$12,400/ea.	2		24,800
General Supplies	Lump Sum	- -		3,000
Labor:				
Supervisor/Operator	$16,000/ea.	1		16,000
Laborer/Truck Driver	$12,000/ea.	1		12,000
Subtotal				$ 59,800
				98,400
TOTAL ANNUAL COST:				$158,200

TABLE VI-6

ALTERNATIVE LC - PROBABLE TRANSFER STATION COSTS
(Compaction Type)

Item	Unit Cost	Units	Capital Cost	Annual Cost
CAPITAL COSTS:				
Facility				
Land	$1,500/acre	2.5 acres	$ 3,750	
Sitework	Lump Sum	- -	40,000	
Building	$45/sf	70' x 50'	157,500	
Utilities	Lump Sum	- -	20,000	
Engineering, Legal & Contingency	Lump Sum	20%	44,250	
Subtotal			$265,500	
Amortization (10% - 20 yrs.)				$ 31,200
Equipment				
Compactor	$50,000/ea.	1	$ 50,000	
Installation	20% of capital	- -	10,000	
Contingency	Lump Sum	10%	6,000	
Subtotal			$ 66,000	
Amortization (10% - 15 yrs.)				$ 8,700
Rolling Stock				
Transfer Trailer	$33,000/ea.	2	$ 66,000	
Transfer Tractor	$45,000/ea.	2	90,000	
Front-end Loader	$25,000/ea.	1	25,000	
Contingency	Lump Sum	10%	18,100	
Subtotal			$100,100	
Amortization (10% - 5 yrs.)				$ 52,500
Total Capital Cost:			$530,500	

TABLE VI-6
(cont.)

Item	Unit Cost	Units	Capital Cost	Annual Cost
ANNUAL OPERATION & MAINTENANCE COST:				
Utilities	Lump Sum	- -		$ 6,000
Insurance	Lump Sum	- -		1,000
Equipment O & M:				
Compactor	Lump Sum	- -		7,500
Tractor/Trailer	$7,700/ea.	2		15,400
General Supplies	Lump Sum	- -		3,000
Labor:				
Supervisor/Operator	$16,000/ea.	1		16,000
Laborer/Truck Driver	$12,000/ea.	1		12,000
Subtotal				$ 60,900
TOTAL ANNUAL COST:				$153,300

landfill; and 4) the cost of Alternative LC is significantly higher than Alternative LA, which is to continue landfilling at Logan.

e. Alternative LD - Direct Haul to Bozeman Landfill
Alternative LD is characterized by the following:

* All solid waste generated in the Logan District would be hauled directly to the Bozeman Landfill.

* Operations at the Logan Landfill will cease.

This alternative was considered because of the lower tipping fee at the Bozeman Landfill compared to the existing Logan landfill costs ($7.26/ton compared to $13.77/ton). The possibility thus exists that it would be less expensive to haul waste a greater distance and pay a lower tipping fee.

The cost for this alternative is summarized below:

ALTERNATIVE LD
DIRECT HAUL TO BOZEMAN LANDFILL

Haul Cost: 6,899.1 tons/year x $0.50/ton-mi x 20 miles:	$ 69,000
Landfill Cost: 6,899.1 tons/year x $7.26/ton:	50,100
TOTAL:	$119,100
COST/TON:	$17.26

The above costs do not include any cost for ceasing operation at the existing Logan Landfill. There are also several disadvantages to this alternative: 1) The Bozeman Landfill has a relatively short life and this additional solid waste would decrease the life even more; 2) The costs for a new Bozeman Landfill may be more than the cost of the Logan Landfill; and 3) The new Bozeman Landfill has not been located, and it may be farther from the Logan Refuse District, increasing haul costs. Since there are a number of unknown factors associated with this alternative, it should be studied further. After the solid waste plan for the Bozeman area has been established, further analysis can be conducted to determine if it would be feasible for the Logan Refuse District to haul solid waste directly to the Bozeman Landfill.

f. Summary
Table VI-7 presents a summary of the system costs for the three landfilling alternatives evaluated for the Logan Refuse District. Although it costs less to haul directly to Bozeman, there are sufficient disadvantages to this alternative, as discussed above, that it should not be considered further at this time. Consideration may be appropriate when the Bozeman solid waste situation has been resolved.

TABLE VI-7

LOGAN REFUSE DISTRICT - LANDFILL OPTIONS

1983 COST SUMMARY AND COMPARISONS

	Alternative	1983 Dollars/Ton Haul	Transfer	Disposal	Total
1.	LA: Continue landfilling at Logan[1]	$ 5.00	- -	$13.77	$18.77
2.	LC: Direct Haul to Bozeman Landfill[2]	10.00	- -	7.26	17.26
3.	LD: Transfer Waste to Bozeman Landfill[3]	5.00	$22.22	7.03	34.25

1 All solid waste is hauled to and disposed of at the Logan Landfill.

2 All solid waste is hauled to and disposed of at the existing Bozeman Landfill.

3 Processable waste is transferred and hauled to the Bozeman Landfill. Non-processable waste (Class III) is hauled to and disposed of at the Logan Landfill.

TABLE VI-8

LOGAN REFUSE DISTRICT
(Resource Recovery vs Landfilling)

1983 Cost Summary

	Alternative	Present Worth[1] (1986 Dollars)
LA:	Continue Landfilling at Logan	$1,972,000
LB1:	Resource Recovery 35 TPD (Steam Only) High Cost	6,224,000
LB2:	Resource Recovery 35 TPD (Steam Only) Low Cost	3,040,000

1 Present worth of net costs (costs-revenues) for a 15-year study period, was developed in Appendix A.

Table VI-8 shows the present worth cost summary for Alternative LA - Continue Landfilling at Logan, and for resource recovery Alternatives LB1 and LB2. This table shows that Alternative LA is the least costly; therefore, it is recommended that the Logan Refuse District continue to landfill at Logan.

4. Bozeman Landfill Service Area

a. Introduction

The Bozeman Landfill Service Area will generate approximately 25,908 tons of solid waste in 1983. Approximately 22,408 tons or 86 percent, will be processable solid waste. It is expected that in the year 2000, approximately 38,214 tons of solid waste will be produced, of which 33,052 tons will be processable. These quantities and monthly fluctuations have been discussed in detail in Part Four. When evaluating alternative solid waste management concepts, it is necessary to consider not only the total solid waste quantity generated, but also the seasonal fluctuations.

Five alternative solid waste management concepts were evaluated for the Bozeman Landfill Service Area. These are briefly described as follows:

* Alternative A - Continue Landfilling. This alternative is based on the concept that landfilling continues to be the prime method for managing solid waste.

* Alternative B - Resource Recovery. This alternative is based on a small resource recovery facility of approximately 40 tons of solid waste per day capacity which would generate steam to be sold to Montana State University. The facility would be able to provide the University's minimum steam demand.

* Alternative C - Resource Recovery. Under this alternative, the capacity of the resource facility would be 100 tons solid waste per day. This facility would generate steam for sale to Montana State University and meet more than the University's minimum steam demand.

* Alternative D - Resource Recovery. Under this alternative, the facility would process 100 tons of solid waste per day and would generate steam for sale to Montana State University and electricity for sale to Montana State University or to Montana Power Company.

* Alternative E - Resource Recovery. This facility would generate only electricity for sale to Montana Power Company. It would be located at or near Bozeman's existing landfill. The capacity of this facility would be 100 tons of solid waste per day.

In the following sections, each alternative is discussed and capital costs and annual operation and maintenance costs are summarized. A flow diagram for each alternative is also shown.

It was necessary to determine probable costs for developing a new landfill to serve the Bozeman area since the alternative resource recovery system, if implemented, will extend the life of the landfill and the economic analysis will be affected by the extended landfill life. It is assumed that the new landfill would be located 20 miles from the city. It was also deemed appropriate to evaluate the economics of hauling directly to the new landfill compared to locating a transfer station at Bozeman and hauling the wastes to the new landfill in transfer trailers. These evaluations are also described in the following sections.

b. Probable Costs of New Landfill

The existing Bozeman Landfill is expected to be filled soon, and at the current and projected rate of solid waste generation a new landfill will be required by 1991 assuming that landfilling continues without resource recovery. Since the fifteen-year planning period extends beyond 1991 (to year 2000), it is necessary to determine probable costs for establishing a new landfill. Because resource recovery reduces the quantity of solid waste going to the landfill, the landfill life is extended. The resource recovery alternatives have different effects on the landfill life; therefore, it is necessary to determine probable landfill costs for landfills implemented at different times. Probable costs for a new landfill were developed for the years shown below:

NEW LANDFILL IMPLEMENTATION YEAR

Alternative	Year Needed
A. Continue Landfilling	1991
B. Resource Recovery 40 TPD (Steam only)	1993
C. Resource Recovery 100 TPD (Steam only)	1995
D. Resource Recovery 100 TPD (Steam & Electricity)	1995
E. Resource Recovery 136 TPD (Electricity only)	1996

Probable landfill costs were initially developed for the year 1983 to establish a base to project costs of subsequent years. The capital costs developed for 1983 were projected at a five percent per year annual increase to arrive at capital costs for 1991, 1993, 1995, and 1996. The capital costs include land, leachate collection system, and liner. It

was assumed that 40 acres would cost $1,500 per acre, or $60,000. A leachate collection system would cost about $0.04 per square foot, or $70,000, and a liner would cost $0.50 to $1.00 per sq.ft. Since the new landfill site has not been located, it was assumed that the liner would cost $0.90 per sq. ft. A salvage value of 50 percent was used for land, and a 20-year life for the landfill was used with a 10 percent interest rate. It was assumed that the new landfill would receive 26,000 tons of solid waste per year. This gives capital costs as shown in Table VI-9.

Operating and maintenance (O&M) costs for the existing landfill were obtained from the City. These costs were used to arrive at a probable cost for a new landfill needed in 1991, 1993, 1995, and 1996.

The operation and maintenance costs for 1983 are shown in Table VI-10. These costs were projected at a five percent per year annual increase to arrive at costs for 1991, 1993, 1995, and 1996. The O&M costs include salaries, fuel, and other supplies, equipment lease, maintenance, utilities, groundwater monitoring, storage building lease, and administrative costs.

Table VI-11 shows the total probable costs for a new landfill which include the capital and O&M costs.

c. Transfer Station Versus Direct Haul

It is assumed that a new landfill for the Bozeman area will be located 20 miles from the City. It is necessary to make a preliminary analysis to determine if it would be economical to construct a transfer station and haul to the new landfill compared to hauling directly to the landfill in each collection vehicle. The costs for a transfer station and haul concept are shown herein.

TRANSFER STATION AND HAUL COSTS

Collection vehicle haul cost	$0.50 or $0.80/ton-mile
Transfer vehicle haul cost	$0.34/ton-mile
Transfer station cost	$1,650,000
Annual capital cost	$194,000
Total solid waste, 1983	25,907.6 tons
Total solid waste, 2000	38,214 tons
Average annual solid waste (between 1983 and 2000)	32,061 tons
Average annual capital cost per ton ($194,000/32,016 tons)	$6.05

Figure 10 shows the cost for a transfer station and transfer haul and the cost for direct haul for the criteria developed above. As indicated in the figure, the break-even point is approximately 38 miles if a direct haul cost of $0.50 per ton-mile is used, whereas the break-even

TABLE VI-9

PROBABLE CAPITAL COST OF A NEW LANDFILL

Item	1983	1991	1993	1995	1996
Land	$ 60,000	$ 88,900	$ 97,734	$ 107,571	$ 113,000
Leachate Collection	70,000	103,442	114,023	125,710	132,000
Liner	871,000	1,286,864	1,418,767	1,564,200	1,642,000
TOTAL	$1,001,000	$1,479,086	$1,630,524	$1,797,661	$1,887,000

TABLE VI-10

PROBABLE ANNUAL O&M COSTS FOR A NEW LANDFILL IN 1983

Item	Annual Cost
Salaries	$ 69,249
Fuel and Other Supplies	19,500
Equipment Lease	57,583
Maintenance	3,500
Utilities	2,000
Groundwater Monitoring	2,400
Storage Building Lease	2,166
Administrative Costs	7,900
TOTAL O&M COSTS	$164,298

TABLE VI-11

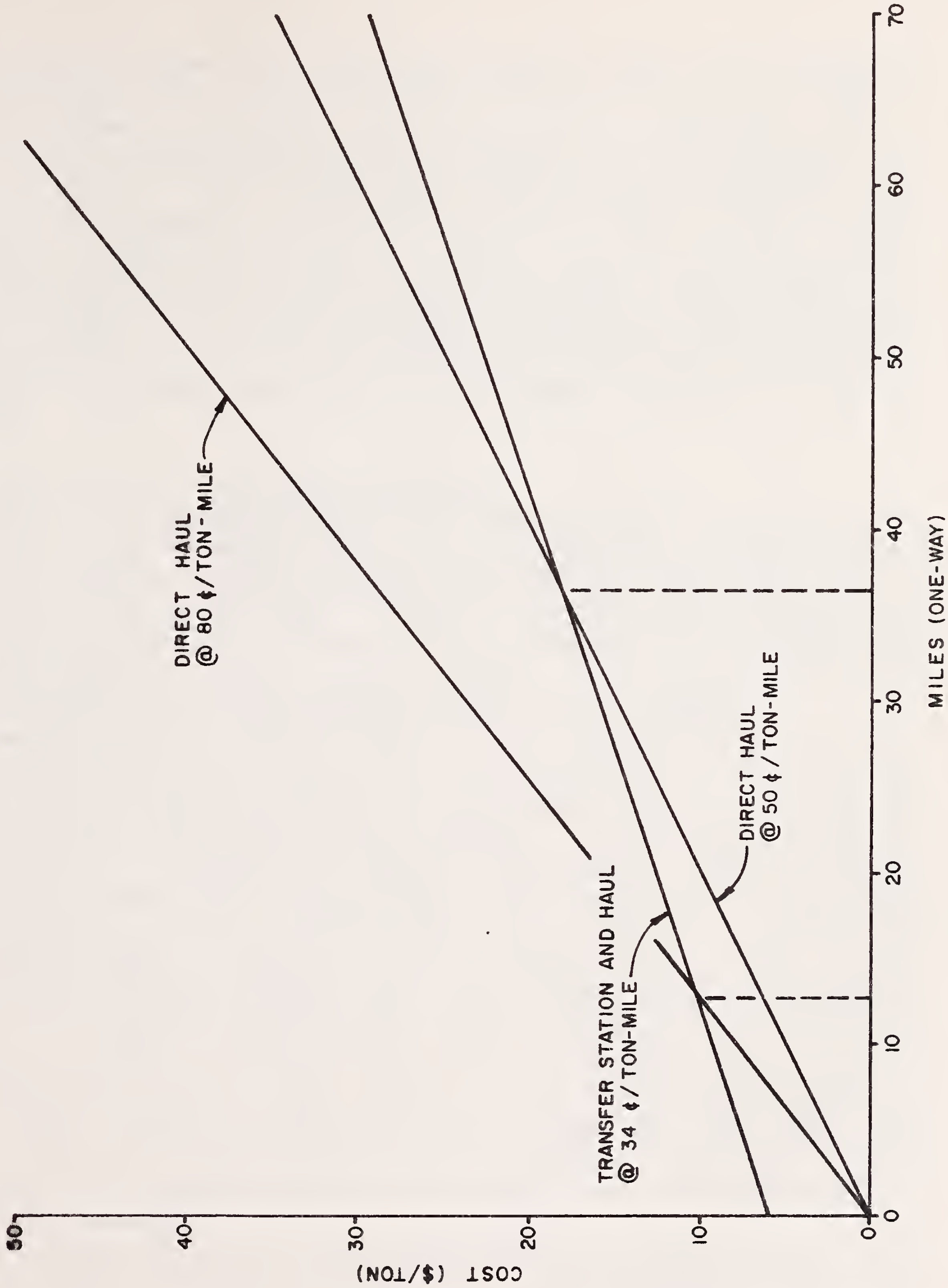
PROBABLE ANNUAL COSTS FOR A NEW LANDFILL[3]

	1983		1991		1993		1995		1996	
	Cost per Ton	Total Cost	Cost per Ton	Total Cost	Cost per Ton	Total Cost	Cost per Ton	Total Cost	Cost per Ton	Total Cost
Capital Cost										
Land	$ 0.25	$ 6,525[1]	$ 0.37	$ 9,620	$ 0.41	$ 10,660	$ 0.45	$ 11,700	$ 0.47	$ 12,200
Leachate Collection System	0.32	8,225[1]	0.47	12,220	0.52	13,520	0.57	14,820	0.60	15,600
Liner	3.93	102,343[1]	5.82	151,320	6.41	166,660	7.07	183,820	7.42	193,000
Subtotal	4.50	117,093[1]	6.66	173,160	7.34	190,840	8.09	210,340	8.49	220,800
O&M Cost	6.32	164,298[2]	9.34	242,840	10.29	267,540	11.35	295,100	11.92	310,000
TOTAL	$10.82	$281,391	$16.00	$416,000	$17.63	$458,380	$19.44	$505,440	$20.41	$530,800

1 Amortization (10%-20 yr.) of the capital costs developed in Table VI-9.

2 Annual O&M cost developed in Table VI-9.

3 1983 annual costs (1) and (2) are escalated on annual rate of 5% for subsequent years.



Gallatin County Solid Waste
Management & Resource Recovery Study

TRANSFER STATION
VERSUS
DIRECT HAUL

Robert Peccia & Associates
Engineers - Planners - Designers
Helena, Montana

Black & Veatch
Engineers - Architects
Kansas City, Missouri

FIGURE 10

point is only 13 miles if a direct haul cost of $0.80 per ton-mile is used. Typically, the higher ton-mile cost can be associated with a three-man collection crew, while the lower haul cost ($0.50/ton-mile) is typical of a one-man collection crew. Therefore, for a 20-mile haul distance, it would be more economical to direct haul if one-man crews were utilized; however, the transfer system alternative would be more economical if three-man collection crews were used. Currently, one-, two- and three-man crews are used in the Bozeman area to collect and transport wastes. Thus, it is reasonable to assume that the break-even distance would be close to the 20-mile haul. Based on this assumption, the direct haul option was used in the economic analysis for each alternative.

d. Alternative A - Continue Landfilling

This alternative assumes that landfilling continues to be the principal solid waste management system for the Bozeman Landfill Service Area. The existing landfill is located approximately three miles northeast of the center of the City. The City of Bozeman has estimated that the existing landfill will be filled and a new landfill will be needed by 1991. For purposes of the economic analysis, it is assumed the new landfill will be located approximately 20 miles from Bozeman.

Operation and maintenance costs for the existing landfill were obtained from the City. The O&M costs were projected at five percent per year annual increase to arrive at a probable cost for a new landfill needed in 1991. These costs include salaries, fuel and other supplies, equipment lease, maintenance, utilities, groundwater monitoring, storage building lease, and administrative costs. Table VI-9 shows the probable capital costs for a new landfill operable in 1991. The capital costs include land, a leachate collection system, and a liner. It was assumed that 40 acres of land would cost $1,500 per acre or $60,000. A leachate collection system would cost about $0.04 per sq ft, or $70,000, and a liner would cost from $0.50 to $1.00 per sq ft. Since a new landfill site has not been located, it was hypothetically assumed that the liner would cost $0.50 per sq ft. These are 1983 costs and were escalated at five percent per year to arrive at 1991 costs. A salvage value of 50 percent was used for land, and a 20-year life was used for the landfill.

The capital cost for a new landfill would be $1,001,000 in 1983 dollars or $1,479,000 in 1991 dollars. The system present worth cost for landfilling is approximately $6,579,000 for a direct haul cost of $.50/ton-mile. For a haul cost of $.80/ton-mile, the system present worth cost is $8,270,000.

The system present worth cost of Alternative A is developed in Appendix A and summarized in Table VI-24.

e. Alternative B - Resource Recovery 40 TPD

(1) Steam Quantity

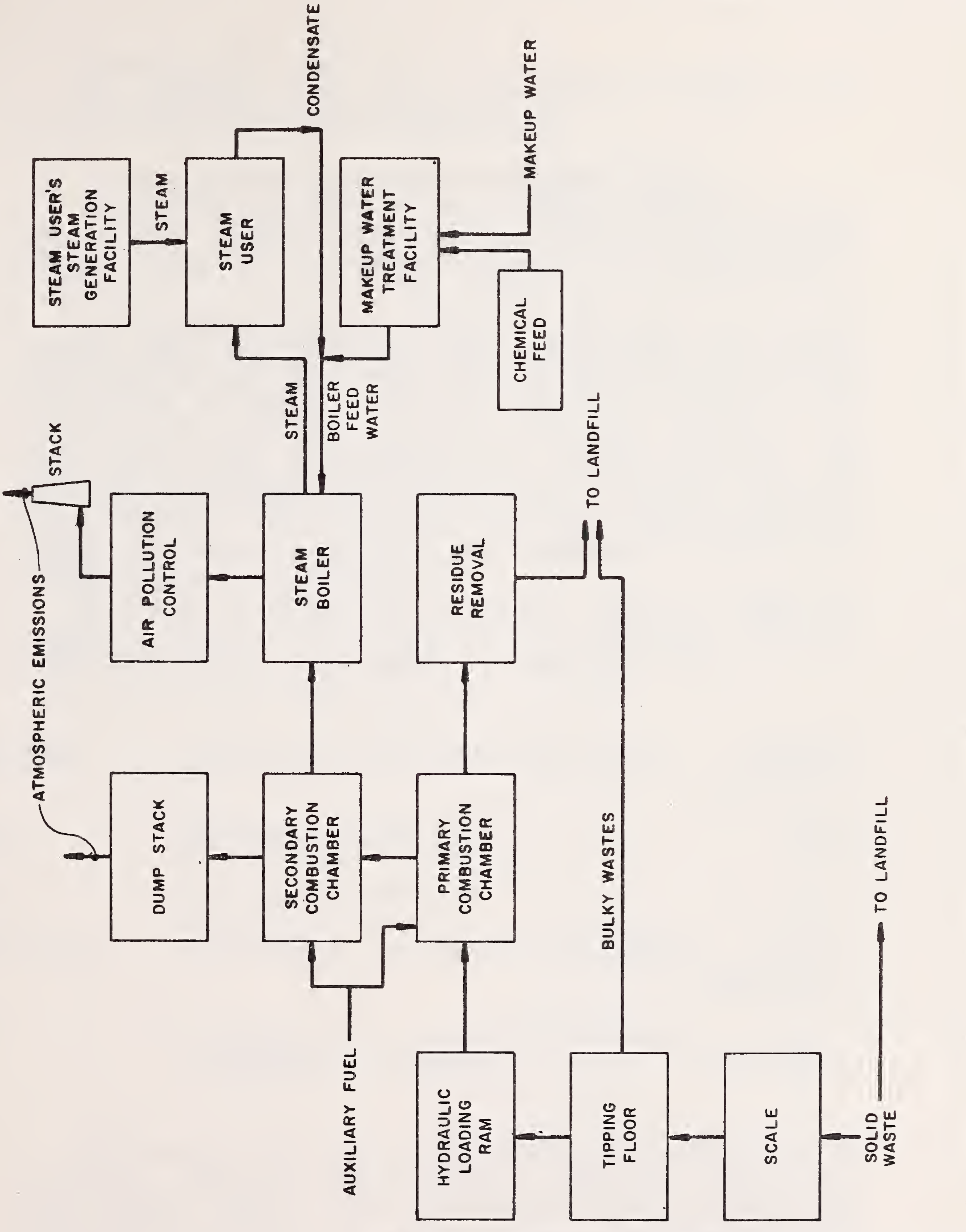
This alternative consists of a facility that would burn approximately 40 tons of solid waste per day and would generate steam for sale to Montana State University. The flow diagram for this alternative is shown on Figure 11. A facility of this size could meet the University's minimum steam demand of 8,000 pounds per hour occurring during the summer. At 2.5 pounds of steam per pound of solid waste, 38.4 tons per day of solid waste is required. The average annual daily quantity of processable solid waste is 61.4 tons in 1983. The minimum daily quantity is approximately 70 percent of the average day, or 43 tons per day and occurs during the winter when the University's steam demand is greater. Therefore, a sufficient amount of solid waste is expected to be generated to provide the minimum hour steam requirements at the University during the summer.

The University does not operate 24 hours a day, 7 days per week year around. During the three summer months, the University does not generate steam between midnight and 8:00 a.m. The annual minimum steam demand is based on the calculations summarized below:

ANNUAL MINIMUM STEAM DEMAND & SOLID WASTE

Total Hours per Year:	8,760
Downtime:	
14 days scheduled maintenance during the summer period (14 days x 24 hrs.)	- 336
Others during the three-month period	- 730
Subtotal: Hours available for operation	7,694
Unscheduled Downtime (15% x 7,694)	- 1,154
Hours Available for Operation:	6,540
Annual Steam Demand: 8,000 lb/hr x 6,540	52,320 Mlb

The annual quantity of solid waste needed to produce 52,320 Mlb of steam per year at 2.5 lb of steam per pound of solid waste is 10,464 tons.



Gallatin County Solid Waste
Management & Resource Recovery Study

ALTERNATIVE B
STEAM GENERATION FLOW DIAGRAM
40 TPD

Robert Peccia & Associates
Engineers-Planners-Designers
Helena, Montana

Black & Veatch
Engineers-Architects
Kansas City, Missouri

FIGURE 11

(2) Probable Capital Cost

The probable capital cost for the facility is based on two 20-TPD units and is shown in Table VI-12.

(3) Probable Annual Operation and Maintenance Costs

Annual O&M costs include labor; utilities consisting of electricity, water, sewers, and natural gas; fuel for the skid steer loaders; maintenance and supplies; insurance; and residue disposal.

Labor requirements are shown in Table VI-13. The plant manager, plant superintendent, scale operator/clerk, and janitor would work an eight hour shift, five days/week. This shift would be 8:00 a.m. to 5:00 p.m. when the solid waste would be received. Each eight-hour shift would have two operators. The fourth shift would be responsible for weekend operation and would require overtime. It is assumed that all vacations would be taken during the two-week plant maintenance period during the summer. The two-week scheduled plant maintenance would be performed under contract by others.

The cost of utilities for a resource recovery facility is basically a factor of the tonnage of waste processed. The estimated utility costs for this facility are summarized below:

Electricity	34 kwh/ton x 10,464 tons x $0.03/kwh	$10,700 ($1.02/ton)
Water	$0.18/ton x 10,464 tons	1,900
Sewer	$0.11/ton x 10,464 tons	1,200
Natural Gas	0.45 MCF/ton x 10,464 tons x $4.59/MCF	21,600 ($2.00/ton)
Fuel	1.5 gallons/hr. x 3,315 hrs/yr/tractor x $1.20/gallon x 2 tractors	12,000 ($1.15/ton)

Maintenance and supplies are estimated to be $4.87/ton or 10,464 tons = $51,000. This also includes maintenance for the skid steer loaders. Residue from the incinerator must be hauled and disposed of at an approved location. It was assumed that the residue would be hauled to the existing Bozeman Landfill until it is full and then to the new landfill, 20 miles away.

Based on the assumptions stated herein, the annual operation and maintenance cost in 1983 dollars was estimated for this alternative. A summary of these costs is shown in Table VI-14. It

TABLE VI-12

PROBABLE CAPITAL COST

ALTERNATIVE B: 40 TONS/DAY CAPACITY

Item	Probable Cost: 1983 Dollars	Probable Cost: Cost/Ton per Day Capacity
1. Land and Site Development	$ 868,000	$ 21,700
2. Incinerator Building	409,000	10,225
3. Two 20 TPD Incinerators with Energy Recovery Units	882,000	22,050
4. Site Work	80,000	2,000
5. Truck Scale	67,000	1,675
6. Steam & Condensate Return Pipeline	75,000	1,875
Direct Construction Costs	$2,381,000	$59,525
7. Contingencies	238,000	5,950
8. Engineering	119,000	2,975
9. Construction Management	48,000	1,200
10. Startup	238,000	5,950
11. Legal & Financing	71,000	1,775
12. Net Interest during Construction	155,000	3,875
PROJECT COST	$3,250,000	$81,250

TABLE VI-13

LABOR REQUIREMENTS
ALTERNATIVE B: 40 TPD FACILITY

Category	Annual Salary[1]	No. of Personnel	Total
Plant Manager	$ 22,000	1	$ 22,000
Plant Superintendent	20,000	1	20,000
Operators	16,000	8	128,000
Scale Operator/Clerk	14,000	1	14,000
Janitor	12,000	1	12,000
Subtotal:			$196,000
Overtime			6,500
Subtotal:			$202,500
Fringe Benefits			40,500
TOTAL			$243,000

1 1983 Dollars

TABLE VI-14

ANNUAL OPERATION & MAINTENANCE COSTS
ALTERNATIVE B: 40 TPD FACILITY

Category	Cost[1]	Cost per Ton of Solid Waste[2]
Labor	$ 243,000	$ 23.22
Electricity	10,700	1.02
Water	1,900	0.18
Sewers	1,200	0.11
Natural Gas	21,600	2.06
Fuel	12,000	1.15
Maintenance and Supplies	51,000	4.87
Insurance	17,800	1.70
Residue		
Fixed Haul Cost	3,234	0.31
Variable Haul Cost	1,866	0.18
Fixed Disposal Cost	- -	0.00
Variable Disposal Cost	30,400	2.91
TOTAL	$400,600	$38.28

1 1983 Dollars
2 Based on 10,464 tons of solid waste per year

should be noted that these costs are probably somewhat conservative, primarily due to the high labor costs.

(3) System Present Worth Cost

The system present worth of the net cost (cost-revenues) for Alternative B over a 15-year study period is developed in Appendix A and summarized in Table VI-24.

f. Alternative C - Resource Recovery 100 TPD Facility (Steam)

(1) Solid Waste and Steam Quantity

This alternative consists of a facility that would burn 100 tons of solid waste per day (8,333 lb/hr) and would generate steam for sale to Montana State University. This facility could provide 20,800 pounds of steam per hour. The flow diagram for this alternative is shown on Figure 12.

Alternative C is based on providing sufficient capacity to burn the processable solid waste generated during the maximum week (1983). The information summarized below depicts how this peak quantity was developed. The quantity of steam that could be generated under this alternative is shown in Table VI-15.

SOLID WASTE QUANTITY
ALTERNATIVE C

Bozeman Landfill Service Area Processable Wastes, 1983	22,408.2 T
Average Week (22,408.2 tons/52 weeks)	430.9 T
Maximum Week (1.5 x 430.9 tons)	646.4 T
Average Day of Maximum Week (646.4 tons/7 days)	92.3 T

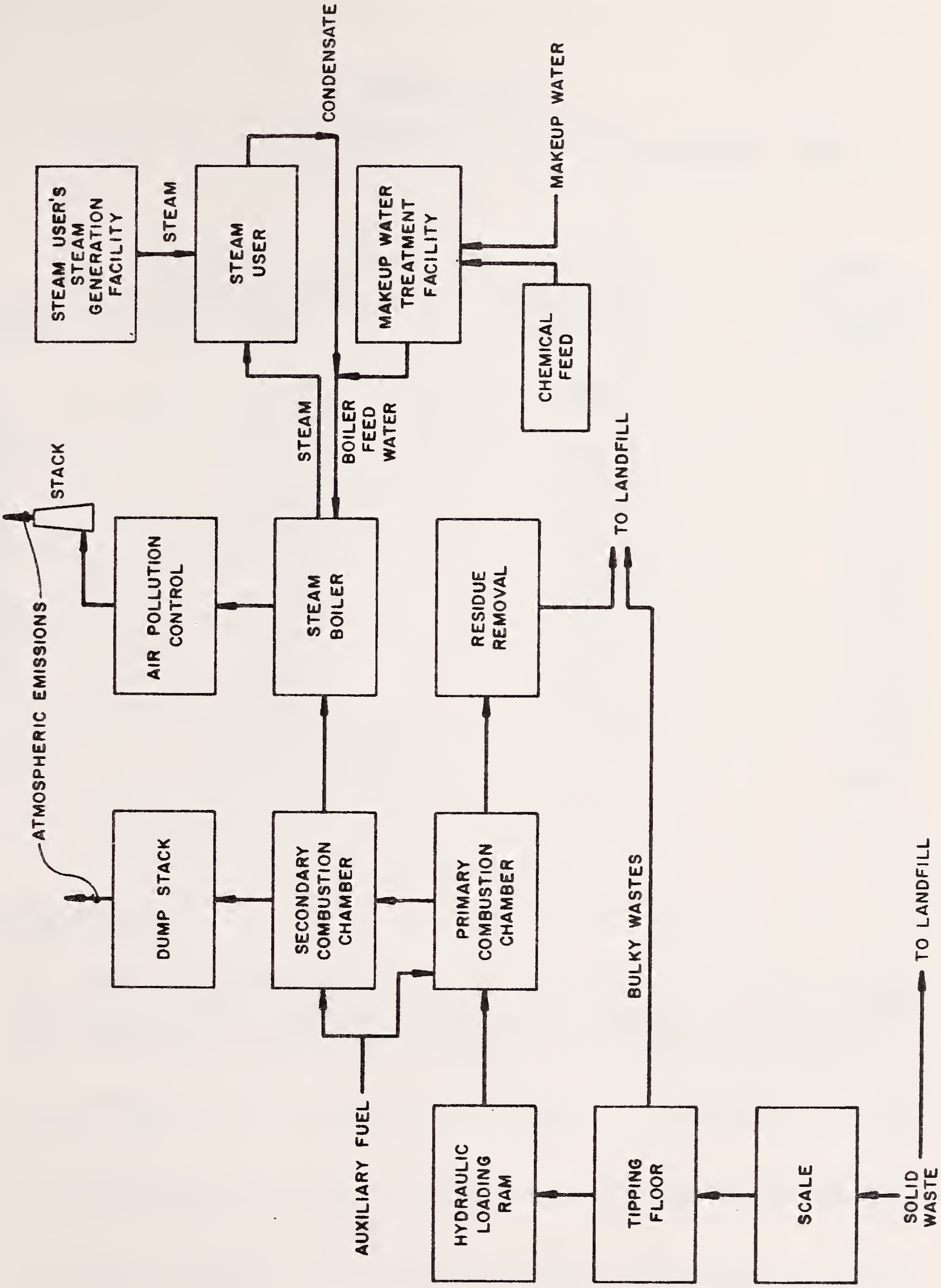
Plant Capacity: 100 Tons/Day

(2) Project Costs

The probable capital costs for this 100 TPD alternative are shown in Table VI-16. The labor requirements and probable annual operation and maintenance costs are shown in Tables VI-17 and VI-18, respectively.

(3) System Present Worth Cost

Four sub-alternatives were evaluated for Alternative C. Alternative C1 is based on the probable capital costs and probable annual operation and maintenance costs developed in Tables VI-16 and VI-18. Alternative C2 is based on the assumption that a $654,000 grant would be obtained which would reduce the probable project cost to $5,000,000. The probable annual operation and



Gallatin County Solid Waste
Management & Resource Recovery Study

ALTERNATIVE C
STEAM GENERATION FLOW DIAGRAM
100 TPD

Robert Peccia & Associates
Engineers-Planners-Designers
Helena, Montana

Black & Veatch
Engineers-Architects
Kansas City, Missouri

FIGURE 12

TABLE VI-15

ALTERNATIVE C - QUANTITY OF STEAM GENERATED - 1983

Month	Processable Solid Waste Available (Tons)	Solid Waste Incinerated (Tons)	Steam Generated (Mlb)
Jan.	1,682.4	1,430.0	7,150
Feb.	1,766.3	1,501.4	7,507
March	2,138.9	1,818.1	9,090
April	2,165.2	1,840.4	9,202
May	1,966.6	1,671.6	8,358
June	2,129.6	1,810.2	9,051
July	2,101.2	1,191.8	5,959
Aug.	2,013.9	625.2	3,126
Sept.	1,795.8	1,017.6	5,088
Oct.	1,486.1	1,263.2	6,316
Nov.	1,566.9	1,331.9	6,660
Dec.	1,595.3	1,356.0	6,780
Totals:	22,408.2	16,857.4	84,287

ASSUMPTIONS:

1. The facility is operating 85 percent of the time in January through June and October through December. The facility is out of service the remaining 15 percent of the time for unscheduled maintenance.

2. The facility is out of service two weeks in August for scheduled maintenance.

3. The University has a steam demand for only 16 hours per day during July, August and September.

4. The facility operates 85 percent of the time during the 16 hours per day.

TABLE VI-16

PROBABLE CAPITAL COST

ALTERNATIVE C - 100 TPD CAPACITY

	Item	Probable Cost: Total Cost	Probable Cost: Cost per TPD Capacity
1.	Land & Site Development[1]	$ 868,000	$ 8,680
2.	Incinerator Building	1,137,000	11,370
3.	Two 50 TPD Incinerators with Energy Recovery Units	1,785,000	17,850
4.	Site Work	186,000	1,860
5.	Truck Scale	67,000	670
6.	Steam & Condensate Return Pipeline	100,000	1,000
	Direct Construction Cost:	$4,143,000	$41,430
7.	Contingencies	414,000	4,140
8.	Engineering	207,000	2,070
9.	Construction Management	83,000	830
10.	Startup	414,000	4,140
11.	Legal & Financing	124,000	1,240
12.	Net Interest During Construction	269,000	2,690
PROJECT COST		$5,654,000	$56,540

1 Includes land purchase, possible demolition, and building replacement, site grading, possible pilings, access roads, utilities and landscaping.

TABLE VI-17

LABOR REQUIREMENTS
ALTERNATIVE C - 100 TPD FACILITY

Category	Annual Salary[1]	No. of Personnel	Total
Plant Manager	$ 22,000	1	$ 22,000
Plant Superintendent	20,000	1	20,000
Operators	16,000	8	128,000
Scale Operator/Clerk	14,000	1	14,000
Janitor	12,000	1	12,000
Subtotal			$196,000
Overtime			6,500
Subtotal			$202,500
Fringe Benefits			40,500
TOTAL			$243,000

1 1983 Dollars

TABLE VI-18

ANNUAL OPERATION & MAINTENANCE COSTS
ALTERNATIVE C - 100 TPD FACILITY

Category	Cost[1]	Cost per Ton of Solid Waste[2]
Labor	$ 243,000	$ 14.41
Electricity	17,200	1.02
Water	3,000	0.18
Sewers	1,800	0.11
Natural Gas	35,000	2.07
Fuel	12,000	0.71
Maintenance and Supplies	82,400	4.89
Insurance	28,700	1.70
Residue		
Fixed Haul Cost	7,000	0.42
Variable Haul Cost	4,000	0.24
Fixed Disposal Cost	- -	0.00
Variable Disposal Cost	49,000	2.91
TOTAL	$483,100	$28.66

1 1983 Dollars
2 Based on 16,857 tons of solid waste per year

maintenance costs would be the same as for Alternative C1. Alternative C3 is based on a probable project cost of $5,654,000 and a reduced operation and maintenance cost. Alternative C4 is based on a $5,000,000 probable project cost and the lower operation and maintenance costs of Alternative C3.

The system present worth values of the net cost (cost-revenues) for each of these alternatives over a 15-year study period are shown in Table VI-24. Detailed development of the present worth costs for Alternative C1 and C4 is shown in Appendix A.

g. Alternative D - Resource Recovery, 100 TPD Facility (Steam and Electricity)

(1) Solid Waste and Steam Quantity

This alternative consists of a facility having capacity to burn 100 tons of solid waste per day (8,333 lb/hr) and that would generate steam for sale to the University and electricity for sale to the University or to Montana Power Company. The flow diagram for this alternative is shown on Figure 13.

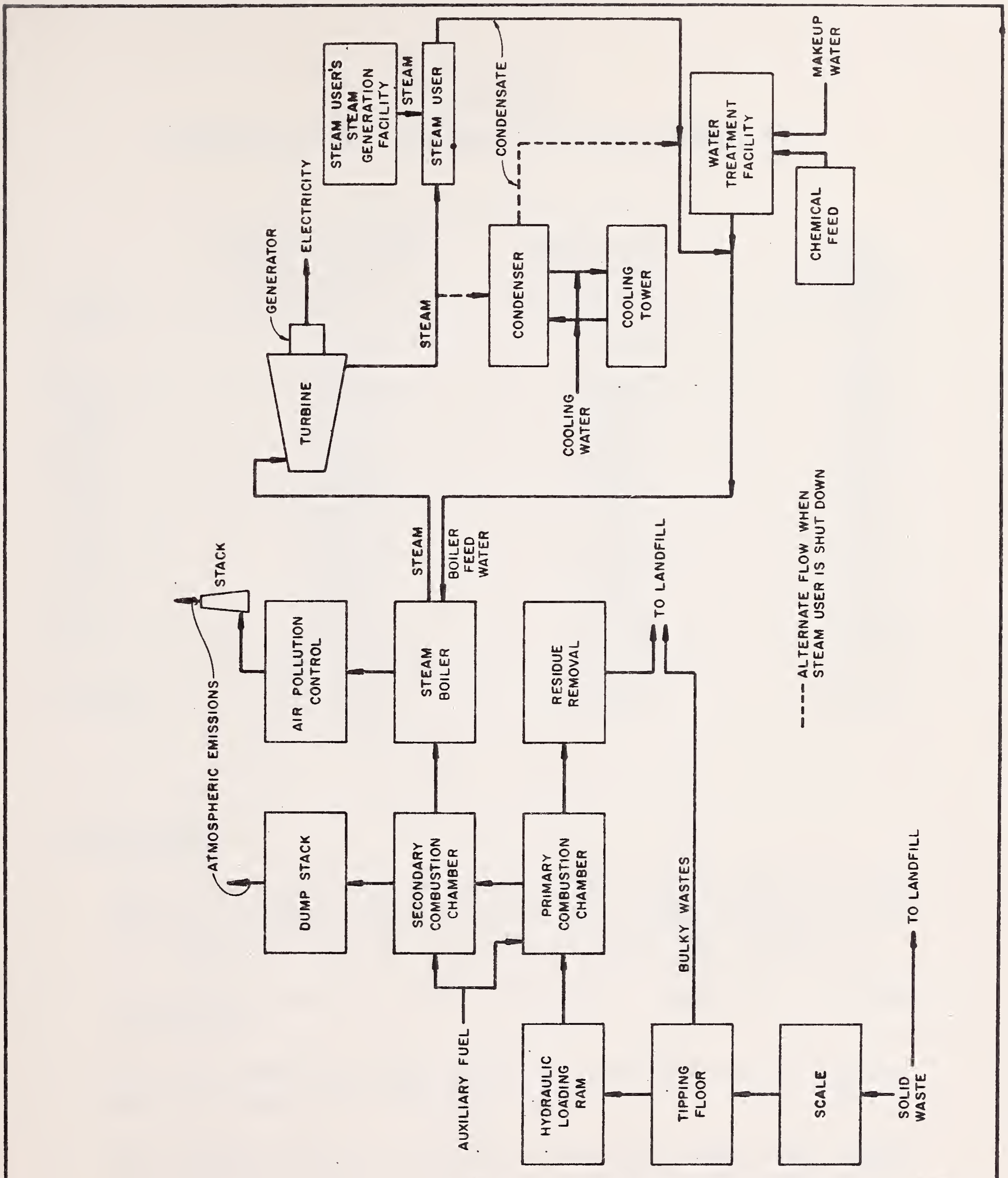
Like Alternative C, Alternative D is based on burning the processable solid waste generated during the maximum week (92.3 tons/day). However, because the Alternative D facility will have the capability of generating both steam and electricity, it will be able to burn more solid waste during the summer months when the University's steam demands are low. Therefore, the quantity of steam generated for sale to the University will be the same as Alternative C, 84,287 Mlb., but the annual quantity of solid waste incinerated will be increased to 18,253 tons. The projected monthly quantities of solid waste incinerated are shown on Table VI-19.

(2) Project Costs

The probable capital and operation and maintenance costs for this alternative are shown in Tables VI-20 and VI-21, respectively. It is assumed that the labor requirement would be similar to those indicated for Alternative C.

(3) System Present Worth Cost

Four sub-alternatives were evaluated for Alternative D. Alternative D1 was evaluated on the basis of the probable costs shown in Tables VI-20 and VI-21 and electrical revenues of 5 cents per kwh. Alternative D2 was evaluated for the same probable costs as Alternative D1, but for electrical revenues of 6 cents per kwh. Alternative D3 was based on the same project costs as Alternative D, receiving a $511,000 grant, lower operation and maintenance cost and electrical revenues of 5 cents per kwh. Alternative D4 is the same as Alternative D3 except for electrical revenues of 6 cents per kwh.



Gallatin County Solid Waste
Management & Resource Recovery Study

ALTERNATIVE D
STEAM-ELECTRICITY GENERATION FLOW DIAGRAM
100 TPD

Robert Peccia & Associates
Engineers-Planners-Designers
Helena, Montana

Black & Veatch
Engineers-Architects
Kansas City, Missouri

FIGURE 13

TABLE VI-19

ALTERNATIVE D - QUANTITY OF STEAM GENERATED

Month	Processable Solid Waste Available (Tons)	Solid Waste Incinerated (Tons)	Steam Generated (Mlb)
Jan.	1,682.4	1,430.0	7,150
Feb.	1,766.3	1,501.4	7,507
March	2,138.9	1,818.1	9,090
April	2,165.2	1,840.4	9,202
May	1,966.6	1,671.6	8,358
June	2,129.6	1,810.2	9,051
July	2,101.2	1,763.1	5,959
Aug.	2,013.9	910.0	3,126
Sept.	1,795.8	1,557.1	5,088
Oct.	1,486.1	1,263.2	6,316
Nov.	1,566.9	1,331.9	6,660
Dec.	1,595.3	1,356.0	6,780
TOTALS	22,408.2	18,253.0	84,287

ASSUMPTIONS:

1. The facility is operating 85 percent of the time in January through June and October through December. The facility is out of service the remaining 15 percent of the time for unscheduled maintenance.

2. The facility is out of service two weeks in August for scheduled maintenance.

3. The University has a steam demand for only 16 hours per day during July, August and September.

4. The facility operates 85 percent of the time during July, August and September. Steam is used to generate electricity when the University does not have a steam demand.

TABLE VI-20

PROBABLE CAPITAL COST

ALTERNATIVE D - 100 TPD CAPACITY
STEAM & ELECTRICITY

	Item	Probable Cost: Total Cost	Probable Cost: Cost per TPD
1.	Land & Site Development	$ 868,000	
2.	Incinerator Building	1,142,000	
3.	Two 50 TPD Incinerators with Energy Recovery Units	2,407,000	
4.	Site Work	186,000	
5.	Truck Scale	67,000	
6.	Steam & Condensate Return Pipeline	600,000	
	Direct Construction Cost:	$4,770,000	$47,700
7.	Contingencies	477,000	
8.	Engineering	239,000	
9.	Construction Management	95,000	
10.	Startup	477,000	
11.	Legal & Financing	143,000	
12.	Net Interest During Construction	310,000	
PROJECT COST		$6,511,000	$65,110

TABLE VI-21

ANNUAL OPERATION & MAINTENANCE COSTS

ALTERNATIVE D - 100 TPD FACILITY
STEAM & ELECTRICITY

Category	Cost[1]	Cost per Ton of Solid Waste[2]
Labor	$ 243,000	$ 13.31
Electricity	26,000	1.42
Water	3,300	0.18
Sewers	2,000	0.11
Natural Gas	38,000	2.08
Fuel	13,000	0.71
Maintenance and Supplies	104,000	5.70
Insurance	31,000	1.70
Residue:		
Fixed Haul Cost	7,600	0.42
Variable Haul Cost	4,400	0.24
Fixed Disposal Cost	- -	0.00
Variable Disposal Cost	53,000	2.90
TOTAL	$494,300	$27.07

1 1983 Dollars

2 Based on 18,253 tons of solid waste per year

The system present worth of net costs (costs-revenues) for each of the alternatives over a 15-year study period is developed in Appendix A and summarized in Table VI-24.

h. Alternative E - Resource Recovery, 136 TPD Facility (Electricity Only)

(1) Solid Waste and Electricity

This alternative is based on a facility that would burn 136 tons of solid waste per day (11,333 lb/hr) and would generate electricity for sale to Montana Power Company. It is assumed that the facility would be located at the present Bozeman landfill. The flow diagram for this alternative is shown on Figure 14. Alternative E is based on providing capacity to burn the processable solid waste generated during the maximum week in 2000. Information on how this quantity was determined are summarized below:

SOLID WASTE QUANTITY
ALTERNATIVE E

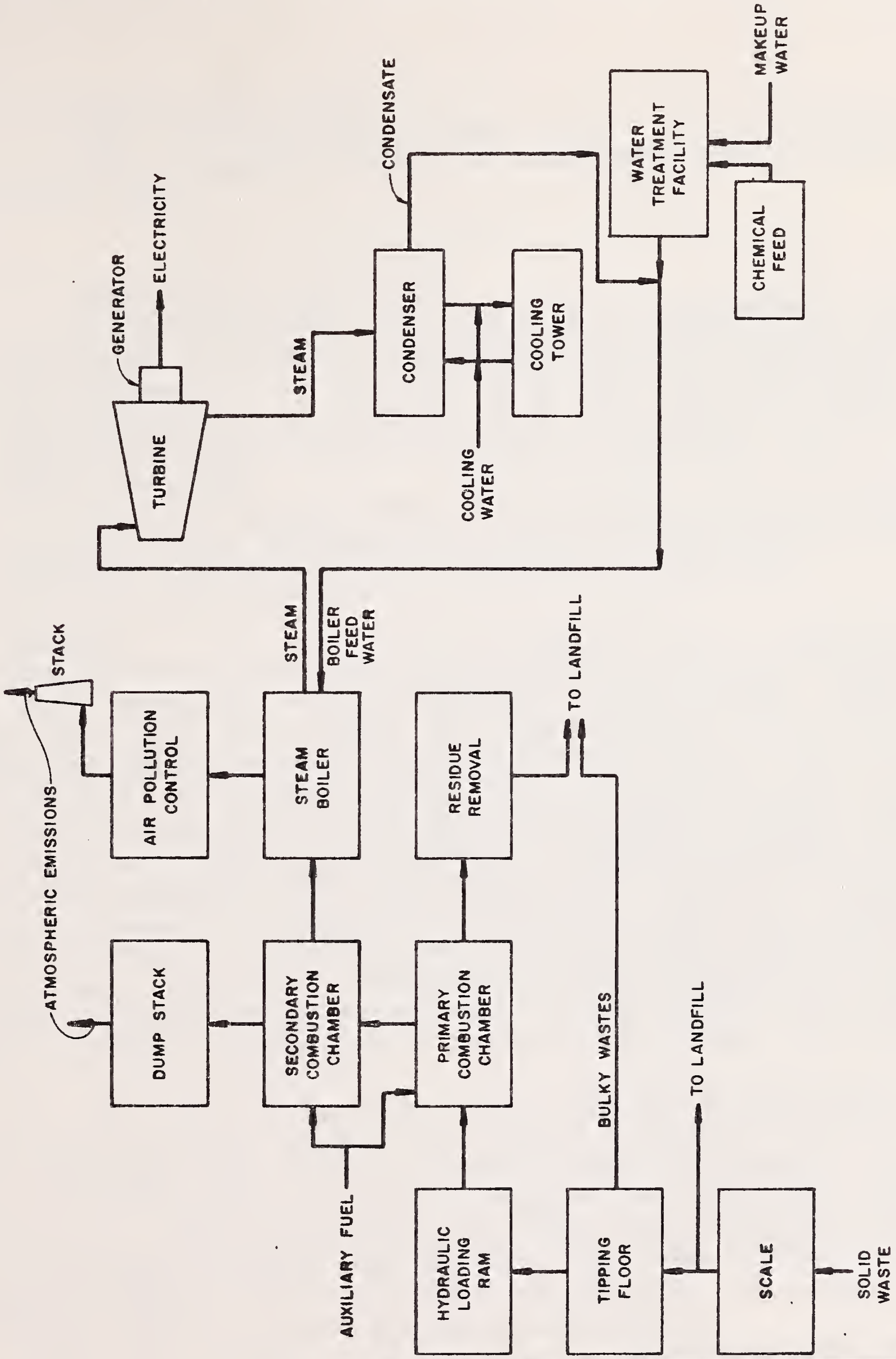
Bozeman Landfill Service Area Processable Waste: (Year 2000)	33,052 T
Average Week (Year 2000) (33,052.1 / 52 weeks)	635.6 T
Maximum Week (Year 2000) (1.5 x 635.6 tons/week)	953.4 T
Average Day of Maximum Week (953.4 tons / 7 days)	136.2 T

Plant Capacity Should be 136 Tons per Day

ANNUAL QUANTITY OF SOLID WASTE TO RESOURCE RECOVERY FACILITY
ALTERNATIVE E

Year	Total Solid Waste (tons)	Processable Solid Waste (tons)	Solid Waste To Resource Recovery Facility[1] (tons)
1983	25,907.8	22,408.2	18,253.0
2000	38,214.0	33,052.1	26,923.0

[1] This allows for downtime for scheduled and unscheduled maintenance.



Gallatin County Solid Waste
Management & Resource Recovery Study

ALTERNATIVE E
ELECTRICITY GENERATION FLOW DIAGRAM
136 TPD

Robert Peccia & Associates
Engineers-Planners-Designers
Helena, Montana

Black & Veatch
Engineers-Architects
Kansas City, Missouri

FIGURE 14

(2) Probable Project Costs

Table VI-22 shows the probable capital cost for Alternative E. The estimated operation and maintenance costs are shown in Table VI-23.

(3) System Present Worth Costs

Two sub-alternatives were evaluated for Alternative E. Alternative E1 is based on the probable project costs and operation and maintenance costs shown in Tables VI-22 and VI-23 and on revenues from sale of electricity at 5 cents per kwh. Alternatives E2 is identical except it is based on receiving 6 cents per kwh for electricity.

The system present worth of the net cost (costs-revenues) for each of these alternatives over a 15-year study period is developed in Appendix A and is summarized in Table VI-24.

i. Summary

Table VI-24 presents a summary of probable costs for alternative solid waste management systems evaluated for the Bozeman Landfill service area. This table shows, for each alternative, the probable project costs in 1983 dollars; the probable system present worth cost for a 15-year study period in 1986 dollars, converted to dollars per ton and dollars per house per month; and the percent change in present worth cost relative to Alternative A - Continue Landfilling. The lowest-cost alternative is D4. This alternative has relatively low capital cost and operation and maintenance costs and is based on receiving 6 cents per Kwh for electricity sold. Probable project costs include costs for land, construction, contingencies, legal and engineering fees, financing, interest during construction, facility startup, and other costs involved in establishing an operable solid waste management system.

The total system present worth cost is the sum of the annual net system costs over the 15-year study period discounted to the first year of operation (1986). The annual gross system costs include annual amortization of capital costs, annual operating and maintenance costs, and costs for hauling solid waste to the solid waste management facilities comprising the system. Annual revenues from sale of steam and/or electricity produced by the system are subtracted from the gross annual system cost to determine annual net system cost.

Total system present worth costs for the alternative solid waste management systems evaluated are developed in Appendix A.

Figure 15 graphs the probable system present worth cost in 1986 dollars for selected alternative solid waste management systems for direct haul cost to the landfill ranging from 50 cents to 80 cents per ton-mile. The figure shows that the landfill option (Alternative A) is substantially more sensitive to change in haul cost than are the resource recovery alternatives, and that the higher the unit haul cost,

TABLE VI-22

PROBABLE CAPITAL COST

ALTERNATIVE E - 136 TPD CAPACITY
ELECTRICITY

	Item	Probable Cost Total Cost	Probable Cost Cost per TPD
1.	Land & Site Development	$ 0	$ 0
2.	Incinerator Building	1,197,000	8,801
3.	Two 50 TPD and one 36 TPD Incinerators with Energy Recovery Facility[1]	3,288,000	24,176
4.	Site Work	218,000	1,603
5.	Truck Scale	67,000	493
6.	Steam & Condensate Return Pipeline	0	0
	Direct Construction Cost:	$4,770,000	$35,023
7.	Contingencies	477,000	3,507
8.	Engineering	239,000	1,757
9.	Construction Management	95,000	699
10.	Startup	477,000	3,507
11.	Legal & Financing	145,000	1,051
12.	Net Interest During Construction	310,000	2,279
PROJECT COST		$6,511,000	$47,873

1 This includes the turbine-generator and associated power generation facilities.

TABLE VI-23

ANNUAL OPERATION & MAINTENANCE COSTS

ALTERNATIVE E - 136 TPD FACILITY
ELECTRICITY

Category	Cost[1]	Cost per Ton of Solid Waste[2]
Labor	$ 323,000	$ 17.70
Electricity	26,000	1.42
Water	3,300	0.18
Sewers	2,000	0.11
Natural Gas	37,800	2.07
Fuel	13,000	0.71
Maintenance and Supplies	104,000	5.70
Insurance	36,000	1.97
Residue		
Fixed Haul Cost	1,900	0.10
Variable Haul Cost	1,100	0.06
Fixed Disposal Cost	- -	0.00
Variable Disposal Cost	53,000	2.90
TOTAL	$607,100	$33.25

1 1983 Dollars

2 Based on 18,253 tons of solid waste per year

TABLE VI-24

PROBABLE COST SUMMARY
BOZEMAN LANDFILL SERVICE AREA

Alternative		Capacity	Energy Product	Project Cost (1983 $)	Total[1]	System Present Worth Cost (1986 Dollars) Cost/Ton[2]	$/House/Month[3]	% Change	Remarks
A.	Continue Landfilling	Varies	None	$ 1,001,000	$ 6,579,000	$ 13.24	$ 1.10	- -	
B1	Resource Recovery	40 TPD	Steam	3,250,000	8,373,000	16.85	1.40	+27.3	High probable project cost; high O & M cost
C1	Resource Recovery	100 TPD	Steam	5,654,000	8,035,000	16.17	1.35	+22.7	High probable project cost; high O & M cost
C2	Resource Recovery	100 TPD	Steam	5,000,000	7,242,000	14.57	1.21	+10.0	Low probable project cost; high O & M cost
C3	Resource Recovery	100 TPD	Steam	5,654,000	7,543,000	15.18	1.27	+15.5	High probable project cost; low O & M cost
C4	Resource Recovery	100 TPD	Steam	5,000,000	6,750,000	13.58	1.13	+2.7	Low probable project cost; low O & M cost
D1	Resource Recovery	100 TPD	Steam	6,511,000	7,576,000	15.24	1.27	+15.5	High probable project cost; high O & M; 5¢/kwh for elect.
D2	Resource Recovery	100 TPD	Steam & Electricity	6,511,000	7,203,000	14.49	1.21	+10.0	High probable project cost; high O & M; 6¢/kwh for elect.
D3	Resource Recovery	100 TPD	Steam & Electricity	6,000,000	6,489,000	13.06	1.09	-0.9	Low probable project cost; low O & M; 5¢/kwh for elect.
D4	Resource Recovery	100 TPD	Steam & Electricity	6,000,000	6,117,000	12.31	1.03	-6.4	Low probable project cost; low O & M; 6¢/kwh for elect.
E1	Resource Recovery	136 TPD	Electricity	6,511,000	16,582,000	33.36	2.78	+152.7	High probable project cost; high O & M; 5¢/kwh for elect.
E2	Resource Recovery	136 TPD	Electricity	6,511,000	16,141,000	32.48	2.71	+146.4	High probable project cost; high O & M; 6¢/kwh for elect.

1 Present worth of net cost (costs-revenues) over a 15-year study period; based on a direct haul cost of $0.50 per ton-mile
2 Based on 497,000 tons over the 15-year period (1986 - 2000)
3 Based on one ton per house per year

BOZEMAN SERVICE AREA ALTERNATIVES ANALYSIS SUMMARY

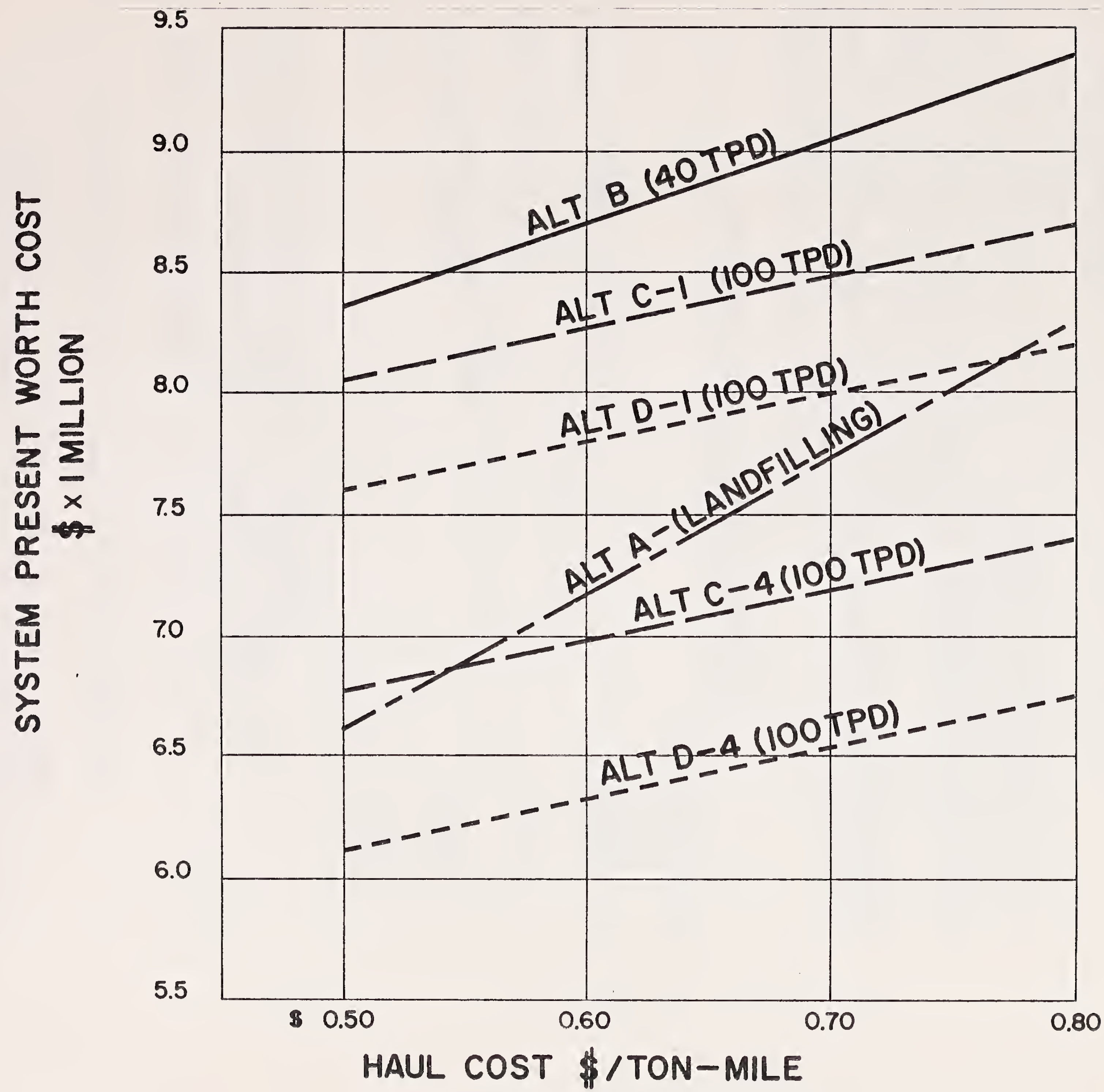


Figure 15

the most cost-competitive resource recovery becomes. Because the present worth cost of Alternative E is approximately twice the cost of the other remaining alternatives, Alternative E was not included on Figure 15.

5. Total County Area

a. Introduction

This alternative is based on the concept of burning all the processable solid waste in the county. The facility would be sized to handle the maximum week in the year 2000. Summarized below are the calculations that show how this quantity was determined. The size of the facility would be 200 TPD (16,667 lb/hr).

The facility would generate steam for sale to Montana State University and electricity for either use by MSU or sale to Montana Power Company. The flow diagram for this alternative is the same as Alternative D and is shown on Figure 13.

PROCESSABLE SOLID WASTE QUANTITY

Area	Processable Waste Year 2000 (tons)
Bozeman Landfill Service Area	33,052.1
Logan Refuse District	8,311.1
West Yellowstone/Hebgen Basin Solid Waste District	3,276.0
TOTAL:	44,639.2

Average Week: 44,639.2 tons/52 = 858.4 tons
Maximum Week: 858.4 tons x 1.5 = 1,287.6 tons
Average Day of Maximum Week: 1,287.6/7 = 183.9 TPD

Size for a 200 TPD Facility

b. Alternative Total County Resource Recovery (200 TPD)

1) Solid Waste, Steam Quality and Electricity Quantity

The resource recovery facility for this total county alternative (F1) is sized for 200 tons per day as previously described. The annual quantity of processable waste that could be burned in 1983 and 2000 is shown on the following page. Solid waste would be burned, and steam and electricity would be generated.

The maximum quantity of steam that would be sold to the University is the same as Alternatives C and E (84,287 Mlbs/yr.) The quantity of electricity is based on 105 kwh/ton of solid waste.

SOLID WASTE TO RESOURCE RECOVERY FACILITY
TOTAL COUNTY

Year	Total Solid Waste (tons)	Processable Solid Waste (tons)	Solid Waste to Resource Recovery Facility[1] (tons)
1983	35,903.3	30,727.6	25,197
2000	52,258.1	44,634.2	36,604

1 This allows for downtime for scheduled and unscheduled maintenance.

2) Probable Project Cost

The probable project cost for this total County resource recovery alternative is shown in Table VI-25.

3) Probable Annual Operation and Maintenance Cost

Annual O & M costs for this alternative are shown on Table VI-26.

4) System Present Worth Costs

The present worth cost of the resource recovery facility for this alternative was determined to be $14,052,000 in 1986 dollars (excluding the haul costs). This is nearly the same as the present worth cost of the resource recovery facility for Alternatives E1 and E2 which were $14,611,000 and $14,171,000, respectively. Because the present worth costs of the other alternatives are substantially less than for this alternative, it does not appear that the total county alternative is feasible at this time.

TABLE VI-25

PROBABLE CAPITAL COST

TOTAL COUNTY - 200 TPD CAPACITY

	Item	Probable Cost: Total Cost	Probable Cost: Cost per TPD
1.	Land & Site Development	$ 886,000	
2.	Incinerator Building	1,568,000	
3.	Four 50 TPD Incinerators with Energy Recovery Units	4,228,000	
4.	Site Work	288,000	
5.	Truck Scale	67,000	
6.	Steam & Condensate Return Pipeline	100,000	
	Direct Construction Cost:	$7,119,000	$35,595
7.	Contingencies	712,000	
8.	Engineering	356,000	
9.	Construction Management	142,000	
10.	Startup	712,000	
11.	Legal & Financing	214,000	
12.	Net Interest During Construction	463,000	
PROJECT COST		$9,718,000	$48,590

TABLE VI-26

ANNUAL OPERATION & MAINTENANCE COSTS

TOTAL COUNTY - 200 TPD FACILITY

Category	Cost[1]	Cost per Ton of Solid Waste[2]
Labor	$ 404,000	$ 16.03
Electricity	36,000	1.43
Water	4,000	0.16
Sewers	3,000	0.12
Natural Gas	50,000	1.98
Fuel	18,000	0.71
Maintenance and Supplies	144,000	5.71
Insurance	50,000	1.98
Residue		
Fixed Haul Cost	65,500	2.60
Variable Haul Cost	1,500	0.06
Fixed Disposal Cost	27,700	1.10
Variable Disposal Cost	111,100	4.41
TOTAL	$914,800	$36.29

1 1983 Dollars

2 Based on 25,197 tons of solid waste per year

PART SEVEN

ALTERNATIVE ACQUISITION STRATEGIES

PART SEVEN

ALTERNATIVE ACQUISITION STRATEGIES

A. GENERAL

Acquisition means buying, renting, or otherwise procuring supplies, services, or facilities. It represents the actual implementation phase of a project. For resource recovery, this implementation follows the establishment of a waste supply for the facility; finding a suitable market for energy and/or materials recovery; analyzing suitable technologies for the wastes and markets available; selecting a site; and determining appropriate methods of financing. Financing methods are discussed in the next chapter. The acquisition approach dictates how the responsibilities for project engineering, design, construction, startup, and operation will be assigned between the public and private sectors. Choices of acquisition and financing alternatives essentially determine how the risks of the project will be assigned, and therefore should not be made lightly.

B. ACQUISITION OPTIONS

Three general approaches for acquiring resource recovery systems and services were considered for Gallatin County:

* Conventional
* Turnkey
* Full Service

The assignments of responsibilities between the County, the Contractor, and the Engineer under each of the three major options are shown in Table VII-1. A general description of the acquisition options follows.

TABLE VII-1

RESPONSIBILITY ASSIGNMENTS FOR
ACQUISITION OPTIONS

Responsibility Assignments	OPTION Conventional	Turnkey	Full Service
Planning	G/E	G/C	G/E
System Design	E	C	C
Preparation and Issuance of System Specifications	E	C	C
Construction Supervision	E	C	C
Construction	C	C	C
Operation	G	G	C
Ownership	G	G	G or C

G: Gallatin County
C: Contractor
E: Engineer

1. Conventional

The conventional or architectural and engineering (A&E) option is the traditional and most widely used approach for procuring public works projects. A professional engineering firm is retained by the County to participate in the planning and design of the project. The engineer, acting as an agent for the County, prepares equipment and system specifications for public bidding. Following bid evaluation and selection of a contractor, an engineer is retained to supervise construction of the project to ensure the use of proper materials, supplies, equipment, etc. Upon completion of construction, the engineer assists in plant startup and testing and might be required to prepare operating manuals for the facility. Once the facility has passed acceptance testing, operation becomes the responsibility of the County, which may either operate the facility itself or contract out its operation to a private firm. The conventional approach thus may involve two

procurements: one for engineering services and one for construction. A third procurement may also be used to obtain an operator if the County does not choose to operate the facility itself.

Examples of resource recovery facilities procured by the conventional A&E approach include those at Akron, Ohio; Albany, New York; Ames, Iowa; Columbus, Ohio; and Harrisburg, Pennsylvania.

2. Turnkey

In the turnkey approach, a single contractor is awarded a contract to design, construct, and start up the facility. The turnkey contractor selects the equipment and supplies to be used and may either design and construct the facility itself or subcontract portions of the work. After completion of construction startup, and successful testing, the project would be accepted by the County, which then assumes responsibility for full scale operation. As in the conventional approach, a second procurement for operating services could be required if the procuring agency does not operate the facility.

Resource recovery facilities procured by the turnkey approach include those at Gallatin, Tennessee (with an engineer as construction manager) and Hampton, Virginia.

3. Full Service

An extension of the turnkey approach is to assign total responsibility for facility design, construction, startup, testing, operation, and ownership to a single full service developer. Under this approach, the procuring agency is provided a service rather than an operable facility.

A variation of the full service approach would involve County ownership of the facility and a leasing arrangement between the County agency and the full service contractor.

Full service projects with contractor ownership include those at Saugus and Pittsfield, Massachusetts. Projects at Dade County and Pinellas County, Florida are full service with government ownership. The Monroe County, New York facility is a modified full service project. The cooperative method is being considered in Grand Rapids, Michigan.

4. Summary of Acquisition Options

A summary of acquisition approaches from the viewpoint of the County is shown in Table VII-2.

TABLE VII-2

COMPARISON OF ACQUISITION OPTIONS

Evaluation Criteria	OPTION		
	Conventional	Turnkey	Full Service
County Workload	Heavy - Moderate	Moderate	Light - Moderate
Planning Cost to County	High	Moderate	Moderate
Lead Time to Implementation	Short	Moderate	Moderate
Capital Costs to County	High	Moderate - High	Low
Potential for Lowest Long-Term Disposal Cost	High	Moderate	Moderate
Risk Sharing Potential	Low	Moderate	High
Overall Risk Assumption by Public	High	Moderate	Low

The capital costs to the County are likely to be lowest with the full-service approach. However, the sharing of rewards will be less. The County will likely experience a light workload with this approach, and will assume less of the risks involved.

C. RISK SHARING UNDER ACQUISITION OPTIONS

Risk may be reduced or allocated among several parties such as the contractor, operator, owner, market, or insurance company. It is important to note that the least risk option may well be the highest cost option, and conversely, the lowest cost option generally involves the highest risk.

The basic difference between the acquisition options is the degree to which risks can be transferred from the procuring agency to private industry. As shown in Table VII-3, risk sharing potential for the County is greatest under a full service approach and least under the conventional approach. In a full service situation, private industry typically provides the following guarantees: project completion within

TABLE VII-3

RISK SHARING FOR ACQUISITION OPTIONS

Key Risks	OPTION Conventional	Turnkey	Full Service
Completion of project construction within specified time frame	G/C	C	C
Construction cost overruns	C	C	C
Satisfaction of acceptance test	C	C	C
Changes in laws and regulations requiring additional capital investment	G	G	G
Operating and maintenance costs	G	G	C
System performance during operation	G	G	C
Solid waste supply, composition, and characteristics	G	G	C/G
Energy product marketing	G	G	C/G

G: Gallatin County
C: Contractor

a specified time frame; maximum capital cost; maximum operating and maintenance cost; and technical performance throughout the operating life of the facility. A turnkey contractor, on the other hand, generally limits its guarantees to the following: timely completion of the project; maximum capital costs; and satisfaction of a pre-specified performance test. Under the conventional approach, timely completion of the project and passage of acceptance testing are the only assurances which could be provided to the County. In most instances, the risk of changing laws and regulations and waste supply would be borne by the County, although a sharing of waste supply risks may be possible under a full service approach. It should be noted that shifting risk to a private contractor would generally increase costs to the County, since the

contractor will require additional financing in order to assume more risk.

All observations about risk assume that the contractor delivers an operating plant that meets reasonable cost expectations. If he does not or goes bankrupt, the County could end up without an operating facility even though it suffers no financial loss. For this reason the financial backing of the contractor is an important criterion for evaluation.

D. RISK MANAGEMENT

1. Sources of Risk

The implementation of a resource recovery project in Gallatin County is different from activities traditionally engaged in by the County. There are many sources of risks concerning resource recovery projects. The risks of primary concern that are unique to resource recovery result from technologies that are relatively new and may appear threatening to the public and may also cause concern to the participants. Major risks include waste volumes and composition that are variable and unpredictable; and project implementation that requires coordination among a large number of participants, including the waste generators and haulers, equipment suppliers, facility operator, facility owner, financial underwriters, and the energy market. In many respects a resource recovery project is more like a manufacturing facility than a typical municipal project.

A discussion of some of the most important risks for the resource recovery projects envisioned for the County follows.

2. Technological Uncertainty

Energy recovery from waste is a fairly recent activity, at least in the United States. Relatively few energy recovery technologies have been demonstrated on a commercial scale in this country. Some element of risk must therefore be considered in planning a facility. The technological risk may contribute to other risks, such as delays in construction or excessive plant downtimes.

* Facility Construction. Risks associated with facility construction may affect capital costs and/or timely startup of the facility.

* Delays in Construction. Delays in completion of construction can result from many causes, including late delivery of components, labor disputes, and force majeure (acts of God, lightning, storms, floods, wars, etc.). Delays could cause cost overruns, loss of revenue from sale of steam, and loss of savings in energy costs.

* Contract Suspension. Contract suspension, for any reason would have the same effects as construction delays.

* Increased Capital Costs. Costs of equipment and/or materials may increase during the construction period, especially if there are delays during construction. If the cost of financing the project is increased, higher amortization costs or interest would increase the cost of processing each ton of waste during the facility's operating life. The entire project could be put in jeopardy if the increases are large enough.

* Facility Operation. Risks associated with facility operation and maintenance can increase annual costs, and in some instances, have caused failure of a facility. Great strides have been taken in recent years to increase the reliability of the mass-burning energy recovery facilities.

* Excessive Plant Downtime. Many factors contribute to plant downtime. The system or its components may fail or require additional work. Strikes or other labor problems, or force majeure events can also lead to downtime. Whatever the cause, downtime could cause loss of revenue from sales of steam and electricity and loss in savings in energy costs.

* Increased Operating Costs. If the feasibility study underestimates costs of labor, utilities, materials, replacement parts, residue disposal, or insurance premiums, or if inflation increases operating costs faster than revenues, then the project may be jeopardized financially. The sensitivity analysis serves to indicate the financial significance of any increased costs.

* Changes in Legislation. Several types of legislation could affect an energy recovery plant. As described earlier, waste reduction measures could change the quantity and composition of the waste stream. More stringent pollution control regulations on air emissions, water discharges, or residue disposal might require costly plant modifications.

* Transportation and Storage. If the storage capacity for incoming waste or outgoing materials is not sufficient to handle emergencies (such as shutdowns, storms, etc.), waste may have to be transported to alternative disposal sites. This could affect project costs and revenues.

3. Marketing of Energy Products

Some general risks associated with marketing energy products are discussed in this section.

* <u>Fluctuations in the Price of Energy</u>. Since the negotiated price for a recovered product, e.g., steam, electricity, is generally tied to the price of a competing fuel, e.g., natural gas, then reductions in the price of the competing fuel may affect the economic viability of a facility.

* <u>Changes in a Purchaser's Circumstances</u>. Events could change the energy purchaser's circumstances, with adverse effects on the project. If a buyer of steam, for example, goes out of business or is unable to pay for deliveries, the project's revenues will be correspondingly diminished. This risk is not as great when the energy market is in the City (district heating) or the County (sewage treatment).

* <u>Contract Duration</u>. Marketing contracts may expire before the investment in the recovery facilities is recovered. This could place the project in a precarious position should the operator be unable to renew the contract or find new buyers.

4. Residue Disposal

Provisions must be made for disposal of residues from the facility, and for disposal of incoming waste if the facility is unable to process waste for any reason. Some risks which have been identified as associated with residue and waste disposal are as follows.

* <u>Disposal Site Location and Capacity</u>. A change in the location, capacity, or other circumstances of the site for disposing of residuals could increase operating costs by requiring a longer haul from the energy recovery plant to the landfill.

* <u>Legislation and Regulations</u>. Regulations may be implemented which require design changes for disposal sites. This would increase the cost of energy recovery system operations.

PART EIGHT

ALTERNATIVE FINANCIAL STRATEGIES

PART EIGHT

ALTERNATIVE FINANCIAL STRATEGIES

A. GENERAL

The purpose of this part is to identify alternative strategies available to Gallatin County for financing a resource recovery facility. The main emphasis is on debt financing alternatives involving the issuance of tax-exempt municipal bonds. Because the interest income on such bonds is exempt from Federal income taxes (Section 101 (a)(1) of the Internal Revenue Code of 1954, as amended), qualified issuers of municipal bonds may borrow at lower rates than private entities of similar creditworthiness. There are cases, however, as discussed below, where the private sector may also avail itself of tax-exempt financing. A more detailed analysis of alternative financial strategies will be necessary in Phase II.

B. MUNICIPAL BONDS

Two general categories of municipal bonds are discussed herein: general obligation bonds (G.O. bonds), and revenue bonds. These bonds differ from one another in their security and source of repayment.

1. G.O. Bonds

Traditionally most large capital improvement projects in Montana have used this method of financing. These bonds are secured by the full faith and credit and taxing power of the issuer. The type of project being financed with the proceeds of G.O. bonds is of little interest to the bondholder since principal and interest on these bonds are payable from the issuer's general fund. If there are insufficient funds from which to make such payments, the issuer is obligated to raise ad valorem taxes to the level necessary to make the payments. A potential lender, therefore, would look only to the issuer's ability and willingness to pay. Ability to pay is measurable--dollar values can be assigned to property and tax returns can be projected. Willingness to pay is more subjective and the potential investor must make an educated guess of the issuer's determination to honor its debt. This is done by examining the issuer's past performance and its bond ratings. An approving vote of the electorate is generally required for issuance of G.O. bonds except under a court-ordered action.

G.O. debt is subject to constitutional and statutory limitations. Interest rates are generally the lowest available to the issuing jurisdiction. Interest rate increases, municipal debt limitations, and referendum requirements have limited the G.O. bonds as a source of funding. The limitation has been made up by issuance of revenue bonds.

2. Revenue Bonds

Revenue bonds are used to finance what are projected to be self-sustaining enterprises and are secured by the revenues arising from the operation of the project being financed. In a resource recovery project, these revenues would include solid waste disposal or "tipping" fees and receipts from sales of recovered energy and/or materials. Unlike G.O. bonds, revenue bonds are limited obligations of the issuer, and the issuer is not legally obligated to raise taxes in order to make principal and interest payments. To secure revenue bonds and therefore enhance their marketability, the issuer usually covenants to maintain rates and charges associated with the use of the facility to a level sufficient to pay both debt service and operating and maintenance expenses. However, the exercise of this power is not always publicly or politically feasible, and therefore it must be demonstrated to potential lenders that the project will be capable of operating as an independent economic unit. Unlike a G.O. bond issue where the cost of the debt is related solely to the credit standing of the issuer, the cost of debt associated with a revenue bond issued for a resource recovery project is dependent on numerous factors, including: (1) the status of the technology being utilized; (2) the issuer's ability to direct the flow of solid waste; and (3) the nature of the contracts for the sale of recovered energy and materials.

Interest rates for revenue bonds are generally higher than for G.O. bonds, although secondary pledges of full faith and credit can be made which may lower the effective bonding rates. A vote of the electorate is usually not required for revenue bonds, although the right to petition for a referendum is usually available. There are no debt limitations if the debt retirement is based solely on facility revenue and is not payable through the general taxing power of the issuers.

C. LEASING

Lease financing usually includes an interest cost higher than a comparable bond issue. Leasing is the rental of equipment or land from its owner for a specified period of time. For example, mobile equipment such as tractors or trucks is commonly leased for a few years. In some cases, long-term leases may be used for equipment having a long useful life. Leasing has the advantage of allowing use of an asset without raising capital. The lease payments can usually be on a current revenue basis. Less administrative work is required than for a bond issue, for example. However, lease rates are generally quite high and may be more expensive overall. Three methods of lease financing are commonly used: straight operating lease, lease purchase agreement, and leveraged lease financing. Of these, leveraged leasing is attracting particular interest for resource recovery projects and is described below.

Leveraged leasing is an innovative and rather sophisticated form of financing. It was applied to a resource recovery project in

Lawrence-Haverhill, Massachusetts. The incentive for leveraged leasing is the pass-through of tax benefits to the lessee. For example, a municipality or private operator could receive lower lease rates from a lessor (a financial institution, which can utilize the tax benefits). The tax benefits include the investment tax credit and deductions for accelerated depreciation and interest.

At least three parties are involved in a leveraged lease as shown on Figure 16:

* A lessee (a municipality or private operator)
* A lessor (usually a financial institution)
* A long-term source of capital (usually obtained through sales of revenue or G.O. bonds)

The lessor owns the facility and is required to invest at least 20 percent of the cost of the project. The 20 percent financing cannot be tax exempt. The remainder of the capital is usually raised through sale of revenue bonds or general obligation bonds. The lessor makes the debt service payments to the long-term capital source. The lessor usually includes private investors who have a high effective tax rate and can realize substantial tax benefits from the arrangement.

The lessee may be a municipality or other public agency, or a private owner. The lessee usually enters into a contract for construction of the facility. The lessee also contracts for delivery of solid waste to the facility, and for sale of the recovered energy and/or material products. The payments received under these contracts allow the lessee to make the lease rental payments to the lessor. Normally at the end of the lease the lessee will have an option to purchase the facility at its fair market value at the time.

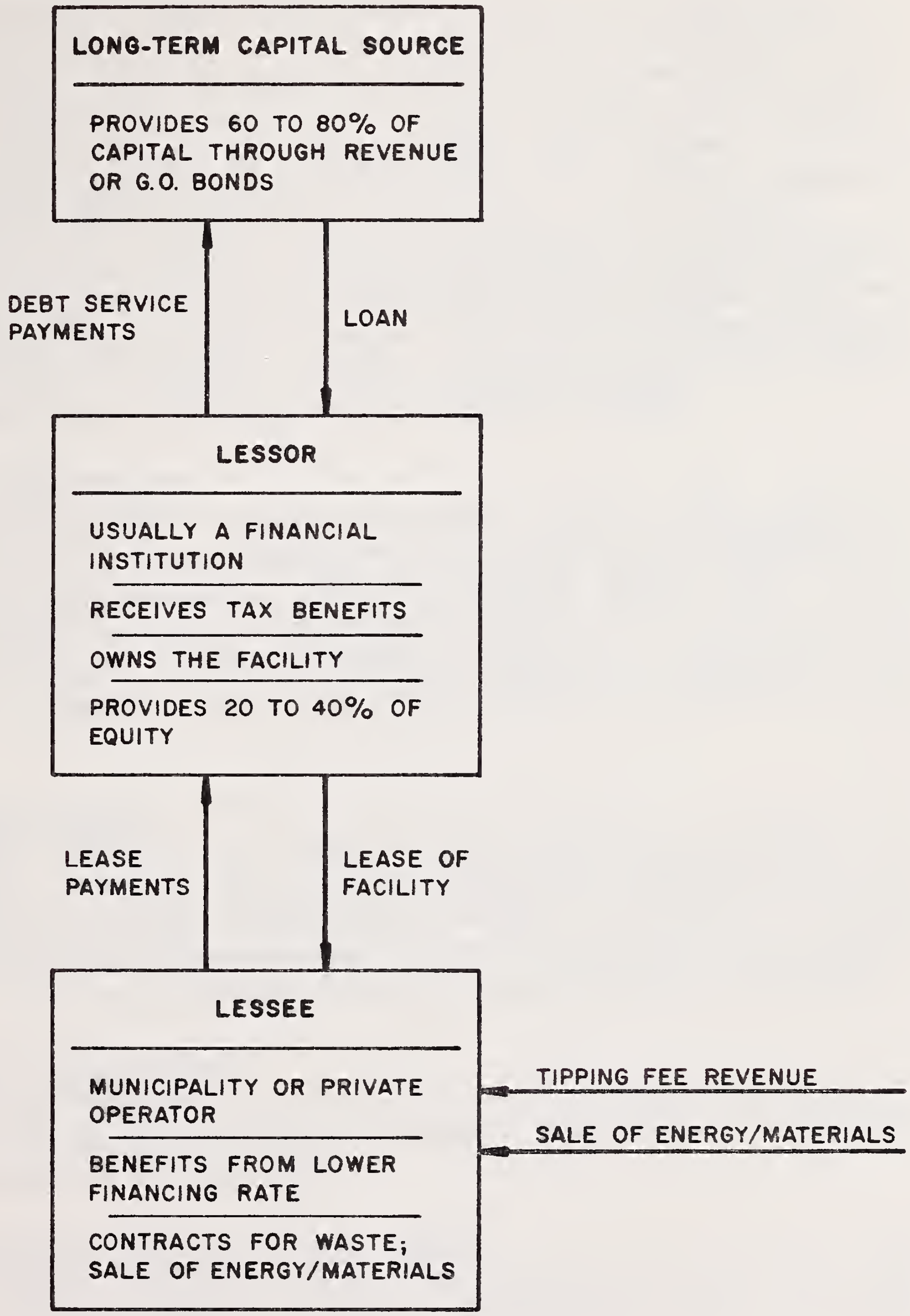
The chief economic justification for leveraged leasing is the tax benefits for the equity investor (the owner/lessor). A private letter ruling from IRS is often required to assure that the tax benefits accrue to the proper party. Extensive legal and financial advice is required for this type of financing.

Although total funding of a project with private equity would be unusual, there has been considerable interest on the part of private investors in the tax benefits from investing 20 percent or more of the project financing.

In summary, leveraged leasing is appropriate:

(1) If the assets being financed produce significant ownership tax benefits.

(2) If the user of the assets is not capable of using those tax benefits on a timely basis.



Gallatin County Solid Waste
Management & Resource Recovery Study

LEVERAGED LEASING STRUCTURE

Robert Peccia & Associates
Engineers · Planners · Designers
Helena, Montana

Black & Veatch
Engineers · Architects
Kansas City, Missouri

FIGURE 16

D. PRIVATE OWNERSHIP

Private ownership allows corporations to take full advantage of the tax benefits. Two types of private ownership arrangements are possible. Under the first method a private enterprise accepts the entire risk and capital demand (private equity and debt) of a project. Risk to the County would be minimal under this method, but its bargaining position might be poor in the event of a contract dispute. The tax advantages that accrue to private investors are as follows.

Under the second method, a private enterprise provides private equity only. The equity would be used with public financing such as Industrial Revenue (Development) Bonds. Under either option, private or public operation is possible. Public operation allows the public agency to maintain some control over the municipal facility.

1. Investment Tax Credit

Taxpayers who own a resource recovery facility which recovers energy can take a 10 percent investment tax credit on new facilities (a non-refundable direct deduction from the Federal income tax). This credit was extended to 1985 by the Windfall Profits Tax Law signed by the President on April 2, 1980. Property designated to convert solid waste to fuel, to store the fuel, or to burn the fuel is eligible for the credit.

2. Energy Tax Credit

A 10 percent energy tax credit is also available to resource recovery facilities. However, the use of tax-exempt financing fully or partially precludes utilizing these energy credits. Therefore, an individual or a corporation contemplating the use of investment tax credits and/or energy tax credits should seek tax counsel before proceeding.

3. Accelerated Depreciation

The Internal Revenue Service (IRS) recently published a guideline whereby private owners could accelerate depreciation of resource recovery facilities for tax purposes.

4. Deduction for Interest or Rental Costs

The IRS allows a private owner a tax deduction for interest paid on debt, or, if the project is leased, a deduction for the full rental payment.

E. STATE AND FEDERAL ASSISTANCE

Less frequently used but worth investigating are sources of State funding. These may take the form of economic development funds such as loans or block grants made available to local governments for development projects. The State may also guarantee bond funds, guaranteeing repayments of all principal and interests on local obligations, thus increasing local bond marketability.

The Federal Government has several programs for providing direct and indirect assistance to local communities in the implementation of resource recovery projects. These include grants, loan guarantees, loans, and price support loans. These are currently extremely limited and may become non-existent, but are worth investigating.

PART NINE

SUMMARY AND RECOMMENDATIONS

PART NINE

SUMMARY AND RECOMMENDATIONS

A. PROJECT SUMMARY

As indicated in the initial chapter of this report, the primary purpose of this project is to evaluate applicable solid waste resource recovery alternatives for the wastes generated in Gallatin County and to determine the potential feasibility of implementing a resource recovery program in the County. The scope of work for this project was divided into two phases. The purpose of this Phase One portion of the project was to identify and evaluate various waste-to-energy alternatives that are potentially feasible. The final result of these analyses will be a recommendation of whether or not to proceed with a more detailed analysis (Phase Two) for the most applicable and feasible resource recovery alternative(s) evaluated. It was intended that this Phase One analysis be rather general in nature, while the Phase Two analysis would be substantially more detailed and site-specific.

Included in the following paragraphs is a brief summary of the analyses conducted for this Phase One portion of the project.

1. Study Area Characteristics

The study area for this project includes all incorporated and non-incorporated areas of Gallatin County. During the last two decades, Gallatin County has experienced significant growth in both population and economy. The majority of this growth has occurred in the Bozeman and Belgrade areas, and may be attributed to the increasingly important role of the city as a trade and services center and the continuing growth of Montana State University. The population of the County increased by nearly 32 percent between 1970 and 1980 after experiencing a 25 percent increase during the previous decade. Current projections of County population for the year 2000 exceed 67,000.

2. Existing Solid Waste Management Conditions

Currently there are three solid waste disposal facilities available to the residents of Gallatin County. These facilities include landfills located near Bozeman and Logan, and a transfer station located near West Yellowstone. The Bozeman landfill is owned and operated by the City of Bozeman; at the present time, approximately 25,900 tons of waste are disposed of at this site annually. Local officials estimate that the site will reach its capacity in the year 1991.

The Logan landfill is under the jurisdiction of Gallatin County Refuse District Number One, which encompasses the western portion of the

County and includes the communities of Belgrade, Manhattan, Three Forks, Logan and Amsterdam. Currently, approximately 6,900 tons of waste are disposed of annually at this site.

The West Yellowstone transfer station is operated under the jurisdiction of the West Yellowstone/Hebgen Basin Refuse District which encompasses the Town of West Yellowstone and the southern portion of Gallatin County. The wastes deposited at the transfer station are transported to the Ennis Landfill. Currently, approximately 3,100 tons of solid waste are deposited annually at the transfer station, which includes approximately 1,200 tons of waste that are generated in Yellowstone National Park and at various Forest Service campgrounds located in the area.

3. Secondary Materials Recovery Analysis

The analysis included herein determined that several tons of potentially recyclable materials including ferrous and aluminum metals, newsprint, cardboard and glass are generated in the County annually. Local markets exist for most of these materials, and currently these materials are being recycled on an individual basis. The potential for recycling at this time is most promising for aluminum beverage cans, due to favorable market conditions.

4. Resource Recovery Alternatives Analysis

The initial efforts for this analysis included the identification of potential energy users for the energy produced from a solid waste resource recovery facility located in the county. After extensive investigation, it was determined that two market situations have the proper energy demand and delivery conditions to warrant an in-depth economic feasibility analysis. These situations include: 1) providing steam to Montana State University to supplement the steam currently being generated at the University's central steam plant; and 2) providing steam to supplement the steam demand for the drying and grinding processes at the Cyprus Industrial Minerals Company talc plant located in Three Forks. In addition to these market situations, the alternative of generating electricity from a resource recovery plant and marketing it to the Montana Power Company was evaluated.

For the MSU steam plant market situation, three alternates were evaluated: 1) utilizing a 40 TPD resource recovery facility that could provide the University with their minimum steam demand (8,000 lbs/hr); 2) utilizing a 100 TPD facility to provide the University with a corresponding volume of steam; and 3) utilizing a 100 TPD cogeneration facility to provide the University with a corresponding quantity of steam and electricity. Based on the analyses conducted herein, it was determined that the most economically feasible option was the 100 TPD cogeneration alternative. A present worth analysis of this option was compared to the cost of continuing to landfill all wastes generated in the Bozeman landfill service area through the year 2000. This analysis indicated that that the two alternatives are cost-competitive.

For the Cyprus Industrial Minerals Company market situation, one resource recovery alternative was evaluated. This included the use of a 35 TPD resource recovery facility that would be sized large enough to handle all wastes generated in the Gallatin County Refuse District Number One. This plant would be capable of producing approximately 15 percent of the Cyprus plant's steam demand. A present worth analysis of this option was compared to the cost of continuing the use of the Refuse District's landfill near Logan through the year 2000. This analysis clearly indicated that the resource recovery option is substantially more expensive than the landfilling alternative.

5. Acquisition and Financing Strategies

For this phase of the project, a general investigation of the alternate acquisition and financing strategies that are potentially applicable to the implementing governmental entity was conducted. The three most appropriate acquisition options are: 1) conventional; 2) turnkey; and 3) full service. Traditionally, the most widely used approach for public works projects is the conventional option.

The alternate financial strategies available for implementing a resource recovery project in the County include the following: 1) municipal bonds (G.O. or revenue); 2) leasing; 3) private equity; and 4) state and federal grant and/or loan programs. Currently, there are very few grant and loan programs available for resource recovery projects. Therefore, the most likely financing methods available are municipal bonds or private equity.

B. RECOMMENDATIONS

Based on the information and analyses compiled for this phase of the project, the following recommendations can be made by the Consultant.

1. Bozeman Landfill Service Area

As a result of the economic analysis conducted and summarized in Part Six of this report, it is recommended that discussions continue between the City of Bozeman, Gallatin County Commission, and officials of Montana State University to evaluate the feasibility of the 100 TPD cogeneration resource recovery facility (Alternative D) which would be located on the MSU campus. Furthermore, it is the consultant's recommendation that the analysis conducted in this phase of the project seems to indicate that the economic feasibility of implementing Alternative D is quite favorable compared to the "Continue Landfill" alternative, and warrants more in-depth analysis in Phase Two of this project. Prior to proceeding with Phase Two, however, it is the consultant's recommendation that a "Notice to Proceed to Phase Two" should be sent to the Technical Committee from the City, the County, the University and other appropriate officials indicating their continued support and interest in the project.

In addition to these recommendations, the consultant also recommends that the local governmental entities proceed with a site selection program for a new landfill in the near future. This recommendation is based primarily on three factors that have come to light during the course of the Phase One analysis: 1) the existing landfill's life will be reached within the foreseeable future (seven years from now, according to local officials); 2) recent data indicate that groundwater contamination may be evident near the existing landfill site; and 3) even if a resource recovery facility is implemented, a landfill will be needed to dispose of Group II wastes when the facility is shut down for scheduled and unscheduled maintenance, Group III wastes (inert materials), and the ash and residue that would be produced by the resource recovery facility.

2. Gallatin County Refuse District No. One

It is recommended that the District continue to utilize its landfill located near Logan. It is also recommended that the District not proceed at this time with further analysis of the resource recovery alternative of at the Cyprus Industrial Minerals Company talc plant at Three Forks. Finally, it is recommended that District officials continue to evaluate the possibility of coordinating and consolidating waste disposal efforts for Bozeman and the area encompassed by the Refuse District.

3. West Yellowstone/Hebgen Basin Solid Waste District

It is recommended that the District continue to transport the wastes disposed of at the transfer station to the Ennis landfill. However, District officials should continue to consider the feasibility of transporting the wastes to either a new landfill or resource recovery facility that would serve the Bozeman area.

APPENDIX A

ECONOMIC FEASIBILITY ANALYSES OF SOLID WASTE MANAGEMENT ALTERNATIVES

APPENDIX A

ECONOMIC FEASIBILITY ANALYSES OF SOLID WASTE MANAGEMENT ALTERNATIVES

A. GENERAL DESCRIPTION OF ANALYSES

Appendix A presents computer printouts showing comparative economic analyses of the solid waste management systems discussed in Section 6 and summarized in Table VI-24. Capital costs and operating and maintenance costs were developed in Section 6 for the elements (i.e., direct haul, transfer, landfill, and energy recovery) of the solid waste management alternatives under consideration. The analyses presented in Appendix A integrate the costs for the appropriate elements into comparable total costs for solid waste management systems. These total system costs are net costs (i.e., total costs less any revenues from energy recovery).

The economic analyses are calculated on the basis of government ownership of the various elements of the solid waste management systems. Therefore, no costs are assigned for taxes or profits and no credits are given for investment tax credits, energy tax credits, or accelerated depreciation, as might be assigned under private ownership.

The economic analysis for each solid waste management system is presented in two parts on two separate computer printouts. The first part, shown on the first printout of each series, (see EXAMPLE PART 1) develops comparative costs over a 15-year study period of a resource recovery system and a landfill system. Each of the two systems is assumed to handle the same annual quantity of solid waste and the costs for hauling solid waste to the two facilities are excluded from the analyses. Therefore, the costs developed by the PART 1 analysis provide a direct economic comparison of an energy recovery facility and a sanitary landfill without regards to haul costs.

The second part of the economic analyses of each solid waste management system, shown on the second printout of each series, (see EXAMPLE PART 2) integrates the costs of the energy recovery system developed in the first part with the cost of hauling solid waste to the facility. In addition, costs are developed for hauling and landfilling the portion of the solid waste not processed by the resource recovery facility. The combined costs of energy recovery, landfill, and hauling provide a basis for direct economic comparison of alternative total solid waste management systems. The total present worth value of net costs over the 15-year study period for the alternative management systems considered in this study are summarized in Table VI-24 of the report.

B. EXPLANATION OF COST FACTORS AND COLUMN HEADINGS ON PART 1 OF COMPUTER PRINTOUTS

1. Factors Listed Above Tables

The following explanations, which are referenced by numbers to the cost factors and assumptions listed on the top portion of EXAMPLE PART 1, apply to the cost factors listed on all of the PART 1 computer printouts of economic analyses in Appendix A.

1. Year Facility Operable - The first full year of operation for the facility.

2. Facility Capacity (ton/year) - The throughput of the facility.

3. Capital Cost, 1983 Dollars - The probable project capital cost in 1983 dollars.

4. Cap Amortization Period (Yrs.) - The expected economic life of the project equals the capital amortization period.

5. Cap Amortization Rate (%) - The interest rate used for amortizing the capital over the economic life of the project.

6. Energy Escalation Rate (%) - The annual percent escalation applied to fuel cost and revenues from electric sales.

7. Labor Cost, 1983 ($) - The probable cost of labor in 1983 dollars.

8. Electrical Cost, 1983 ($/ton) or ($) - The cost of electricity for the facility in dollars/ton or dollars.

9. Water Cost, 1983 ($/ton) or ($) - The cost of water for the facility in dollars/ton or dollars.

10. Sewer Cost, 1983 ($/ton) or ($) - The cost of sewer service in dollars/ton or dollars.

11. General O&M Escalation Rate (%) - The annual percent escalation applied to most O&M costs (except fuel).

12. Present Worth Discount Rate (%) - The interest rate used in determining present worth values of future costs or revenues.

13. Natural Gas Cost, 1983 ($/ton) or ($) - The cost of natural gas (auxiliary fuel) for the resource recovery facility in dollars/ton or dollars.

14. Fuel Cost, 1983 ($/ton) or ($) - The cost of fuel for the skid steer loaders.

15. Maintenance and Supplies Cost, 1983 ($/ton) or ($) - The average annual cost of maintenance and supplies over the economic life of the project.

16. Insurance Cost, 1983 ($) - The annual cost of insurance for the facility.

17. Fixed Disposal Cost (1983 $/ton) - Annual amortization of the capital cost of facilities for disposing of residue from the resource recovery facility expressed in dollars/ton.

18. Var Disposal Cost (1983 $/ton) - The O&M cost for disposing of residue from the resource recovery facility.

19. Disposal Escalation Rate (%) - The annual escalation rate applied to the O&M element of disposal cost.

20. Fixed Haul Cost (1983 $/ton-mile) - Annual amortization of the cost of hauling residue to the landfill expressed in dollars/ton-mile.

21. Var Haul Cost (1983 $/ton-mile) - The O&M cost of hauling residue to the landfill expressed in dollars/ton-mile.

22. Disp Haul Escalation Rate (%) - The annual escalation rate applied to the variable O&M portion of the haul cost.

23. Disposal Haul Distance (miles) - The distance from the resource recovery facility to the landfill.

24. Alt Fixed Disp Cost (2005 $/ton) - Annual amortization of the capital cost of the alternative disposal facility.

The year indicates when the new disposal facility will be operational.

25. Alt Var Disp Cost (2005 $/ton) - The O&M cost of the alternative disposal facility expressed in dollars/ton.

26. Alt Fixed Haul (2005 $/ton-mile) - Annual amortization of the capital cost for hauling residue to the alternate disposal site.

27. Alt Var Haul (2005 $/ton-mile) - The O&M cost for hauling residue to the alternate disposal site.

28. Alternative Disp Dist (mile) - The distance of the alternate disposal site from the resource recovery facility.

29. Alternative Disposal Required By - The year in which a new landfill facility is required.

30. Alternative Disp Esc Rate (%) - The escalation rate applied to the O&M cost of the alternative landfill.

31. Steam Generation - (Mlb/ton) or (Mlb/year) - The quantity of steam generated in thousand pounds per ton of solid waste or thousand pounds per year.

32. Price of Steam (1983 $/Mlb) - The unit price expected for the sale of steam expressed in dollars/thousand pounds of steam.

33. Steam Cost Escalation Rate (%) - The annual escalation rate applied to the steam price.

34. Electricity Generated (Kwh/ton) or (Kwh) - The quantity of electricity generated in kilowatt hours per ton of solid waste or kilowatt hours per year.

35. Price of Electricity ($/Kwh) - The unit price expected for the sale of electricity expressed in dollars/kilowatt hours.

36. Summary:

    Net Present Value - The net present worth of costs (costs less steam/electricity revenues) for the system over the 15-year study period.

Uniform Annual Cost - The net present value amortized over the 15-year study period.

Uniform Cost Per Ton - The uniform annual cost divided by the average annual tons of solid waste for the 15-year study period.

2. Column Headings

The following explanations, which are referenced by numbers to the column headings on EXAMPLE PART 1, apply to the column headings on all of the PART 1 computer printouts of economic analyses in Appendix A.

Column 1 - Year - The year of operation.

Column 2 - Waste to Res Rec Fac - The annual quantity of solid waste delivered to the resource recovery facility (throughput)

Column 3 and 4 - Capital Cost - Column 3 is the uniform annual amortized capital cost. Column 4 is Column 3 divided by Column 2.

Column 5 - Labor Cost - The annual labor cost.

Column 6 - Elect Cost - The annual cost of electricity.

Column 7 - Water Cost - The annual cost of water.

Column 8 - Sewer Cost - The annual cost of sewer service.

Column 9 - Gas Cost - The annual cost of auxiliary fuel (natural gas).

Column 10 - Fuel Cost - The annual cost of fuel for the skid steer loaders.

Column 11 - Supp Cost - The annual cost of maintenance and supplies.

Column 12 - Insur Cost - The annual cost of insurance.

Columns 13, 14, and 15 - Residue Disposal - Column 13 is the annual quantity of residue. Column 14 is the unit cost of residue disposal. Column 15 is the total cost of disposal (Column 14 x Column 13).

Columns 16, 17, and 18 - Residue Disposal Haul - The cost of hauling the residue to the disposal site. Column 16 is the ton-mile haul cost. Column 17 is the distance from the resource recovery facility to the disposal site. Column 18 is the total annual residue haul cost (Column 17 x Column 16).

Columns 19 and 20 - Total O&M - Column 19 is the total annual operation and maintenance cost (the sum of Columns 5 through 12, 15, and 18). Column 20 is Column 19 divided by Column 2.

Columns 21 and 22 - Revenues - Column 21 is the annual revenue expected from the sale of steam. Column 22 is the annual revenue expected from the sale of electricity.

Column 23 - Res Rec Net Cost - The net annual cost of the resource recovery facility (Column 3 + Column 19 - Column 21 - Column 22).

Column 24 - Tip Fee - The tipping fee required to recover the cost of the resource recovery facility (Column 23 divided by Column 2).

Column 25 - Res Rec Present Work Cost - The net annual cost of resource recovery converted to present worth cost in 1986 dollars.

Columns 26 through 29 - Landfill Costs - Column 26 is the same as Column 2. Column 27 is the unit cost for landfilling solid waste. Column 28 is the total annual cost for landfill (Column 26 x Column 27). Column 29 is the annual present worth cost for landfilling the solid waste in 1986 dollars. Columns 25 and 29 provide a direct comparison of the costs of resource recovery and landfill exclusive of hauling costs.

C. EXPLANATION OF COST FACTORS AND COLUMN HEADINGS ON PART 2 OF COMPUTER PRINTOUTS

1. Factors Listed Above Tables

The following explanations, which are referenced by numbers to the cost factors and assumptions listed on the top portion of EXAMPLE PART 2, apply to all of the PART 2 computer printouts of economic analyses in Appendix A.

1. Year Facility Operable - The first full year of operation for the facility.

2. Facility Capacity (ton/year) - The annual capacity (throughput) of the facility. In some alternatives, the capacity is the same throughout the planning period. In others, it increases each year.

3. Landfill Fixed Cost (1983 $/tons) - The annual amortization of landfill capital costs expressed in dollars/tons.

4. Landfill Var Cost (1983 $/ton) - Landfill O&M costs expressed in dollars/ton.

5. Landfill Escalation Rate (%) - The annual escalation rate applied to landfill variable (O&M) costs.

6. LF Fixed Haul Cost (1983 $/ton-mile) - Annual amortization of capital cost for facilities for hauling solid waste from the collection area to the landfill, expressed in dollars/ton-mile.

7. LF Var Haul Cost (1983 $/ton-mile) - O&M cost for hauling solid waste to the landfill, expressed in dollars/ton-mile.

8. Landfill Haul Escalation Rate (%) - The annual escalation applied to landfill variable (O&M) haul costs.

9. Landfill Distance (miles) - The distance from the centroid of solid waste generation to the existing landfill.

10. Alt Landfill Fixed Cost (2005 $/ton) - The year that an alternative landfill will be required and the annual

amortization of capital cost of the landfill in that year expressed in dollars/ton.

11. Alt Landfill Var Cost (2005 $/ton) - O&M cost of landfilling for the alternate landfill for the year shown, expressed in dollars/ton.

12. Alternate Landfill Required By - The year an alternate landfill will be required.

13. Alt Fixed Haul Cost (2005 $/ton-mile) - Annual amortization of capital cost of facilities to haul to the alternative landfill and the resource recovery facility for the year shown, expressed in dollars/ton-mile.

14. Alt Var Haul Cost ($2005 $/ton-mile - The O&M cost for haul to the alternative landfill or resource facility for the year shown.

15. Alternate Landfill Distance (miles) - Assumed distance from a new landfill to the centroid of solid waste generation.

16. Recovery Fixed Haul Cost (2005 $/ton-mile) - Annual amortization of the capital cost of facilities for hauling solid waste to the resource recovery facility, expressed in dollars/ton-mile.

17. Recovery Var Haul Cost (2005 /$/ton-mile) - O&M cost for hauling solid waste to the resource recovery facility, expressed in dollars/ton-mile.

18. Recovery Haul Escalation Rate (%) - The annual escalation rate applied to the variable (O&M) cost to the resource recovery facility.

19. Recovery Haul Distance (miles) - The distance from the centroid of waste generation to the resource recovery facility.

20. Present Worth Discount Rate (%) - The interest rate used for determining present worth value of future expenditures or revenues.

2. Column Headings

The following explanations, which are referenced by numbers to the column headings on EXAMPLE PART 2, apply to the column headings on all of the PART 2 computer printouts of economic analyses in Appendix A.

Column 1 - Year - The year of operation.

Column 2 - Annual Solid Waste - The quantity of solid waste to be disposed of by the solid waste management system.

Column 3 - Waste to Recovery Facility - The quantity of solid waste delivered to the resource recovery facility.

Column 4 - Waste to Landfill - The quantity of solid waste delivered to the landfill (Column 2 - Column 3).

Columns 5 and 6 - Landfill Cost - Column 5 is the unit cost of landfilling and Column 6 is the total cost of landfilling (Column 4 x Column 5).

Columns 7, 8, and 9 - Haul to Landfill Cost - Column 7 is the unit haul cost. Column 8 is the haul distance. Column 9 is the total haul cost (Column 4 x Column 7 x Column 8).

Columns 10 and 11 - Haul to Recovery Facility Cost - Column 10 is the unit haul cost. Column 11 is the total cost. (Column 3 x Column 10 x Factor 19 upper table).

Column 12 - Resource Recovery Facility Cost - The net annual cost of the resource recovery facility (Column 23 from PART 1).

Columns 13 and 14 - Total Solid Waste System Costs - Column 13 is the sum of Columns 6, 9, 11, and 12. Column 14 is Column 13 divided by Column 2.

Column 15 - System Present Worth - The annual net solid waste system costs (Column 13) converted to annual present worth values in 1986 dollars.

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE L A - CONTINUE LANDFILLING

PROJECT NO. 10989.100
NOVEMBER 25, 1983
LOGAN REFUSE DISTRICT

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	2005
FACILITY CAPACITY(TONS/YR)	varies	ALT FIXED HAUL COST (2005$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	2.75	ALT VAR HAUL COST (2005$/ton-mile)	0.00
LANDFILL VAR COST (1983$/ton)	11.02	ALTERNATE LANDFILL DISTANCE (miles)	0
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(2005$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(2005$/ton-mile)	0.00
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	11
LANDFILL DISTANCE (MILES)	10	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (2005$/ton)	0.00		
ALT LANDFILL VAR COST (2005$/ton)	0.00		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST		HAUL TO LANDFILL COST			HAUL TO RECOVERY FACILITY COST		RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS		SYSTEM PRESENT WORTH COST
				unit	total	unit	distance	total	unit	total		total	unit	
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	7480	0	7480	15.51	115990	0.58	10	43294	0.00	0	0	159284	21.30	159284
1987	7673	0	7673	16.14	123887	0.61	10	46636	0.00	0	0	170522	22.22	155020
1988	7867	0	7867	16.81	132281	0.64	10	50203	0.00	0	0	182483	23.20	150813
1989	8061	0	8061	17.52	141204	0.67	10	54010	0.00	0	0	195214	24.22	146667
1990	8254	0	8254	18.26	150690	0.70	10	58072	0.00	0	0	208763	25.29	142588
1991	8448	0	8448	19.03	160774	0.74	10	62406	0.00	0	0	223180	26.42	138577
1992	8641	0	8641	19.85	171493	0.78	10	67028	0.00	0	0	238521	27.60	134639
1993	8835	0	8835	20.70	182887	0.81	10	71956	0.00	0	0	254842	28.84	130774
1994	9029	0	9029	21.60	194997	0.86	10	77209	0.00	0	0	272206	30.15	126986
1995	9222	0	9222	22.54	207869	0.90	10	82808	0.00	0	0	290677	31.52	123275
1996	9416	0	9416	23.53	221549	0.94	10	88773	0.00	0	0	310323	32.96	119643
1997	9609	0	9609	24.57	236088	0.99	10	95128	0.00	0	0	331217	34.47	116089
1998	9803	0	9803	25.66	251539	1.04	10	101897	0.00	0	0	353436	36.05	112615
1999	9996	0	9996	26.81	267957	1.09	10	109105	0.00	0	0	377061	37.72	109221
2000	10190	0	10190	28.01	285402	1.15	10	116778	0.00	0	0	402180	39.47	105907
SUM					2844607			1125302				3969909		1972100

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE LB1 - RESOURCE RECOVERY, 35 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 26, 1983
LOGAN REFUSE DISTRICT

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	VARIES
CAPITAL COST, 1983 DOLLARS	2433000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	243000
ELECTRICAL COST, 1983 ($/TON)	1.02
WATER COST, 1983 ($/TON)	0.18
SEWER COST, 1983 ($/TON)	0.11
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10

NATURAL GAS COST, 1983 ($/TON)	2.06
FUEL COST, 1983 ($/TON)	1.15
MAINT & SUPP COST, 1983 ($/TON)	4.87
INSURANCE COST, 1983 ($)	15000
FIXED DISPOSAL COST (1983 $/ton)	2.75
VAR DISPOSAL COST (1983 $/ton)	11.02
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.26
VAR HAUL COST (1983$/ton-mile)	0.15
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	6
ALT FIXED DISP COST (2005 $/ton)	0.00

ALT VAR DISP COST (2005$/ton)	0.00
ALT FIXED HAUL (2005$/ton-mile)	0.00
ALT VAR HAUL (2005$/ton-mile)	0.00
ALTERNATIVE DISP DIST (miles)	0
ALTERNATIVE DISP REQUIRED BY	2005
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/TON)	5
PRICE OF STEAM(1983$/Mlb)	4.28
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh/TON)	0
PRICE OF ELECTRICITY($/kwh)	0

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	5362680	1156252
UNIFORM ANNUAL COST($)	705052	152017
UNIFORM ANNUAL COST($/TON)	97.84	21.10

OPERATION AND MAINTENANCE COSTS

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	6101	353	57.81	281	8	1	1	15	8	34	17	2440	15.51	38	0.43	6	6	410	67.28	160	0	603	98.87	603	6101	15.51	95	95
1987	6259	353	56.35	295	8	1	1	17	9	37	18	2503	16.14	40	0.44	6	7	434	69.33	176	0	611	97.63	555	6259	16.14	101	92
1988	6416	353	54.96	310	9	1	1	19	9	40	19	2567	16.81	43	0.45	6	7	459	71.50	193	0	619	96.45	511	6416	16.81	108	89
1989	6574	353	53.64	326	10	2	1	20	10	43	20	2630	17.52	46	0.46	6	7	485	73.78	211	0	627	95.31	471	6574	17.52	115	87
1990	6732	353	52.38	342	11	2	1	22	11	46	21	2693	18.26	49	0.47	6	8	513	76.18	231	0	634	94.20	433	6732	18.26	123	84
1991	6890	353	51.18	359	12	2	1	24	12	50	22	2756	19.03	52	0.48	6	8	542	78.71	253	0	642	93.12	398	6890	19.03	131	81
1992	7048	353	50.04	377	13	2	1	27	13	53	23	2819	19.85	56	0.49	6	8	573	81.36	277	0	649	92.05	366	7048	19.85	140	79
1993	7206	353	48.94	396	14	2	1	29	13	57	24	2882	20.70	60	0.50	6	9	606	84.15	303	0	656	90.99	336	7206	20.70	149	77
1994	7364	353	47.89	416	16	2	1	32	14	61	26	2946	21.60	64	0.52	6	9	641	87.08	332	0	662	89.93	309	7364	21.60	159	74
1995	7522	353	46.89	436	17	2	1	35	16	66	27	3009	22.54	68	0.53	6	10	678	90.15	363	0	668	88.84	283	7522	22.54	170	72
1996	7680	353	45.92	458	19	3	2	38	17	71	28	3072	23.53	72	0.54	6	10	717	93.39	396	0	674	87.74	260	7680	23.53	181	70
1997	7837	353	45.00	481	21	3	2	42	18	76	30	3135	24.57	77	0.56	6	10	758	96.78	432	0	679	86.59	238	7837	24.57	193	67
1998	7995	353	44.11	505	23	3	2	45	19	81	31	3198	25.66	82	0.57	6	11	802	100.34	472	0	683	85.40	218	7995	25.66	205	65
1999	8153	353	43.25	530	25	3	2	50	20	87	33	3261	26.81	87	0.59	6	11	849	104.07	515	0	686	84.15	199	8153	26.81	219	63
2000	8311	353	42.43	557	27	3	2	54	22	93	34	3324	28.01	93	0.60	6	12	898	107.99	562	0	688	82.83	181	8311	28.01	233	61
SUM		5290												928			134	9366				9780		5363				1156

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE LB1 - RESOURCE RECOVERY, 35 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 26, 1983
LOGAN REFUSE DISTRICT

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	2005
FACILITY CAPACITY(TONS/YR)	VARIES	ALT FIXED HAUL COST (2005$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	2.75	ALT VAR HAUL COST (2005$/ton-mile)	0.00
LANDFILL VAR COST (1983$/ton)	11.02	ALTERNATE LANDFILL DISTANCE (miles)	0
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	11
LANDFILL DISTANCE (MILES)	10	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (2005$/ton)	0.00		
ALT LANDFILL VAR COST (2005$/ton)	0.00		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	7480	6101	1379	15.51	21387	0.58	10	7983	0.58	38843	603168	671380	89.76	671380
1987	7673	6259	1415	16.14	22843	0.61	10	8599	0.61	41840	611036	684318	89.18	622107
1988	7867	6416	1451	16.81	24391	0.64	10	9257	0.64	45041	618857	697545	88.67	576483
1989	8061	6574	1486	17.52	26036	0.67	10	9959	0.67	48456	626591	711042	88.21	534216
1990	8254	6732	1522	18.26	27785	0.70	10	10708	0.70	52101	634194	724788	87.81	495040
1991	8448	6890	1558	19.03	29645	0.74	10	11507	0.74	55989	641616	738756	87.45	458710
1992	8641	7048	1593	19.85	31621	0.78	10	12359	0.78	60136	648800	752916	87.13	425001
1993	8835	7206	1629	20.70	33722	0.81	10	13268	0.81	64557	655683	767229	86.84	393710
1994	9029	7364	1665	21.60	35955	0.86	10	14236	0.86	69270	662195	781656	86.58	364648
1995	9222	7522	1700	22.54	38328	0.90	10	15269	0.90	74293	668256	796146	86.33	337644
1996	9416	7680	1736	23.53	40851	0.94	10	16369	0.94	79645	673780	810645	86.10	312539
1997	9609	7837	1772	24.57	43532	0.99	10	17540	0.99	85347	678670	825089	85.86	289189
1998	9803	7995	1808	25.66	46380	1.04	10	18788	1.04	91419	682818	839406	85.63	267461
1999	9996	8153	1843	26.81	49408	1.09	10	20117	1.09	97886	686105	853516	85.38	247233
2000	10190	8311	1879	28.01	52624	1.15	10	21532	1.15	104771	688400	867327	85.12	228394
SUM					524507			207491				11521760		6223755

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE LB2 - RESOURCE RECOVERY, 35 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 26, 1983
LOGAN REFUSE DISTRICT

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	VARIES
CAPITAL COST, 1983 DOLLARS	1933000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	95000
ELECTRICAL COST, 1983 ($/TON)	0.70
WATER COST, 1983 ($/TON)	0.12
SEWER COST, 1983 ($/TON)	0.08
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10
NATURAL GAS COST, 1983 ($/TON)	1.40
FUEL COST, 1983 ($/TON)	0.78
MAINT & SUPP COST, 1983 ($/TON)	3.70
INSURANCE COST, 1983 ($)	6500
FIXED DISPOSAL COST (1983 $/ton)	0.00
VAR DISPOSAL COST (1983 $/ton)	4.95
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.00
VAR HAUL COST (1983$/ton-mile)	0.14
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	6
ALT FIXED DISP COST (2005 $/ton)	0.00
ALT VAR DISP COST (2005$/ton)	0.00
ALT FIXED HAUL (2005$/ton-mile)	0.00
ALT VAR HAUL (2005$/ton-mile)	0.00
ALTERNATIVE DISP DIST (miles)	0
ALTERNATIVE DISP REQUIRED BY	2005
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/TON)	5
PRICE OF STEAM(1983$/Mlb)	4.28
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh/TON)	0
PRICE OF ELECTRICITY($/kwh)	0

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	2178508	447704
UNIFORM ANNUAL COST($)	286417	58861
UNIFORM ANNUAL COST($/TON)	39.75	8.17

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	6101	280	45.93	110	5	1	1	10	6	26	8	2440	5.73	14	0.16	6	2	183	29.93	160	0	303	49.64	303	6101	5.73	35	35
1987	6259	280	44.77	115	6	1	1	11	6	28	8	2503	6.02	15	0.17	6	2	194	30.97	176	0	298	47.69	271	6259	6.02	38	34
1988	6416	280	43.67	121	6	1	1	13	6	30	8	2567	6.32	16	0.18	6	3	206	32.06	193	0	293	45.72	242	6416	6.32	41	34
1989	6574	280	42.62	127	7	1	1	14	7	33	9	2630	6.63	17	0.19	6	3	218	33.22	211	0	287	43.72	216	6574	6.63	44	33
1990	6732	280	41.62	134	8	1	1	15	7	35	9	2693	6.97	19	0.20	6	3	232	34.43	231	0	281	41.69	192	6732	6.97	47	32
1991	6890	280	40.67	140	8	1	1	17	8	38	10	2756	7.31	20	0.21	6	3	246	35.71	253	0	273	39.61	169	6890	7.31	50	31
1992	7048	280	39.75	147	9	1	1	18	9	40	10	2819	7.68	22	0.22	6	4	261	37.05	277	0	264	37.47	149	7048	7.68	54	31
1993	7206	280	38.88	155	10	1	1	20	9	43	11	2882	8.06	23	0.23	6	4	277	38.47	303	0	254	35.26	130	7206	8.06	58	30
1994	7364	280	38.05	162	11	2	1	22	10	47	11	2946	8.47	25	0.24	6	4	294	39.96	332	0	243	32.97	113	7364	8.47	62	29
1995	7522	280	37.25	171	12	2	1	24	11	50	12	3009	8.89	27	0.25	6	5	312	41.53	363	0	230	30.58	98	7522	8.89	67	28
1996	7680	280	36.48	179	13	2	1	26	11	54	12	3072	9.33	29	0.26	6	5	332	43.18	396	0	216	28.09	83	7680	9.33	72	28
1997	7837	280	35.75	188	14	2	1	28	12	57	13	3135	9.80	31	0.28	6	5	352	44.91	432	0	200	25.48	70	7837	9.80	77	27
1998	7995	280	35.04	197	15	2	1	31	13	62	14	3198	10.29	33	0.29	6	6	374	46.73	472	0	182	22.73	58	7995	10.29	82	26
1999	8153	280	34.37	207	17	2	1	34	14	66	14	3261	10.81	35	0.31	6	6	397	48.65	515	0	162	19.83	47	8153	10.81	88	26
2000	8311	280	33.71	218	18	2	2	37	15	70	15	3324	11.35	38	0.32	6	6	421	50.66	562	0	139	16.77	37	8311	11.35	94	25
SUM		4203												363			62	4298				3625		2179				448

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE LB2 - RESOURCE RECOVERY, 35 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 26, 1983
LOGAN REFUSE DISTRICT

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	2005
FACILITY CAPACITY(TONS/YR)	VARIES	ALT FIXED HAUL COST (2005$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	2.75	ALT VAR HAUL COST (2005$/ton-mile)	0.00
LANDFILL VAR COST (1983$/ton)	11.02	ALTERNATE LANDFILL DISTANCE (miles)	0
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	11
LANDFILL DISTANCE (MILES)	10	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (2005$/ton)	0.00		
ALT LANDFILL VAR COST (2005$/ton)	0.00		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	7480	6101	1379	15.51	21387	0.58	10	7983	0.58	38843	302855	371067	49.61	371067
1987	7673	6259	1415	16.14	22843	0.61	10	8599	0.61	41840	298452	371734	48.44	337940
1988	7867	6416	1451	16.81	24391	0.64	10	9257	0.64	45041	293334	372022	47.29	307456
1989	8061	6574	1486	17.52	26036	0.67	10	9959	0.67	48456	287425	371876	46.14	279396
1990	8254	6732	1522	18.26	27785	0.70	10	10708	0.70	52101	280639	371233	44.98	253557
1991	8448	6890	1558	19.03	29645	0.74	10	11507	0.74	55989	272885	370025	43.80	229757
1992	8641	7048	1593	19.85	31621	0.78	10	12359	0.78	60136	264062	368177	42.61	207826
1993	8835	7206	1629	20.70	33722	0.81	10	13268	0.81	64557	254059	365605	41.38	187613
1994	9029	7364	1665	21.60	35955	0.86	10	14236	0.86	69270	242756	362217	40.12	168977
1995	9222	7522	1700	22.54	38328	0.90	10	15269	0.90	74293	230022	357912	38.81	151790
1996	9416	7680	1736	23.53	40851	0.94	10	16369	0.94	79645	215714	352579	37.45	135934
1997	9609	7837	1772	24.57	43532	0.99	10	17540	0.99	85347	199677	346095	36.02	121304
1998	9803	7995	1808	25.66	46380	1.04	10	18788	1.04	91419	181739	338327	34.51	107802
1999	9996	8153	1843	26.81	49408	1.09	10	20117	1.09	97886	161717	329128	32.92	95337
2000	10190	8311	1879	28.01	52624	1.15	10	21532	1.15	104771	139409	318336	31.24	83828
SUM					524507			207491				5366333		3039583

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE A - CONTINUE LANDFILLING

PROJECT NO. 10989.100
NOVEMBER 8, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	varies
LANDFILL FIXED COST (1983$/ton)	0.00
LANDFILL VAR COST (1983$/ton)	7.26
LANDFILL ESCALATION RATE(%)	5
LF FIXED HAUL COST(1983$/ton-mile)	0.00
LF VAR HAUL COST (1983$/ton-mile)	0.50
LANDFILL HAUL ESCALATION RATE(%)	5
LANDFILL DISTANCE (MILES)	3
ALT LANDFILL FIXED COST (1991$/ton)	6.66
ALT LANDFILL VAR COST (1991$/ton)	9.34

ALTERNATE LANDFILL REQUIRED BY	1991
ALT FIXED HAUL COST (1991$/ton-mile)	0.00
ALT VAR HAUL COST (1991$/ton-mile)	0.74
ALTERNATE LANDFILL DISTANCE (miles)	20
RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
RECOVERY HAUL ESCALATION RATE(%)	5
RECOVERY HAUL DISTANCE(miles)	1
PRESENT WORTH DISCOUNT RATE (%)	10

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	0	28080	8.40	235991	0.58	3	48759	0.58	0	0	284750	10.14	284750
1987	28804	0	[illegible]	8.82	254179	0.61	3	52516	0.61	0	0	306695	10.65	278814
1988	29527	0	29527	9.27	273595	0.64	3	56528	0.64	0	0	330123	11.18	272829
1989	30251	0	30251	9.73	294318	0.67	3	60809	0.67	0	0	355127	11.74	266812
1990	30975	0	30975	10.22	316428	0.70	3	65378	0.70	0	0	381806	12.33	260779
1991	31699	0	31699	16.00	507185	0.74	20	469146	0.74	0	0	976331	30.80	606225
1992	32423	0	32423	16.47	533909	0.78	20	503853	0.78	0	0	1037761	32.01	585789
1993	33147	0	33147	16.96	562082	0.82	20	540857	0.82	0	0	1102939	33.27	565982
1994	33871	0	33871	17.47	591796	0.86	20	580302	0.86	0	0	1172098	34.61	546792
1995	34595	0	34595	18.01	623146	0.90	20	622339	0.90	0	0	1245485	36.00	528207
1996	35318	0	35318	18.58	656234	0.94	20	667129	0.94	0	0	1323363	37.47	510214
1997	36042	0	36042	19.18	691166	0.99	20	714843	0.99	0	0	1406009	39.01	492798
1998	36766	0	36766	19.80	728057	1.04	20	765660	1.04	0	0	1493717	40.63	475944
1999	37490	0	37490	20.46	767027	1.09	20	819772	1.09	0	0	1586798	42.33	459639
2000	38214	0	38214	21.15	808203	1.15	20	877380	1.15	0	0	1685584	44.11	443867
SUM					7843317			6845271				14688587		6579441

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE A - CONTINUE LANDFILLING

PROJECT NO. 10989.100
NOVEMBER 4, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1991
FACILITY CAPACITY(TONS/YR)	varies	ALT FIXED HAUL COST (1991$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1991$/ton-mile)	1.18
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	1.18
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1991$/ton)	6.66		
ALT LANDFILL VAR COST (1991$/ton)	9.34		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	0	28080	8.40	235991	0.93	3	78014	1.37	0	0	314005	11.18	314005
1987	28804	0	28804	8.82	254179	0.97	3	84026	1.43	0	0	338205	11.74	307453
1988	29527	0	29527	9.27	273595	1.02	3	90445	1.51	0	0	364040	12.33	300859
1989	30251	0	30251	9.73	294318	1.07	3	97295	1.58	0	0	391613	12.95	294224
1990	30975	0	30975	10.22	316428	1.13	3	104604	1.66	0	0	421033	13.59	287571
1991	31699	0	31699	16.00	507185	1.18	20	748098	1.18	0	0	1255283	39.60	779432
1992	32423	0	32423	16.47	533909	1.24	20	803440	1.24	0	0	1337349	41.25	754899
1993	33147	0	33147	16.96	562082	1.30	20	862447	1.30	0	0	1424529	42.98	731009
1994	33871	0	33871	17.47	591796	1.37	20	925346	1.37	0	0	1517142	44.79	707758
1995	34595	0	34595	18.01	623146	1.43	20	992379	1.43	0	0	1615525	46.70	685140
1996	35318	0	35318	18.58	656234	1.51	20	1063801	1.51	0	0	1720035	48.70	663148
1997	36042	0	36042	19.18	691166	1.58	20	1139885	1.58	0	0	1831051	50.80	641772
1998	36766	0	36766	19.80	728057	1.66	20	1220917	1.66	0	0	1948974	53.01	621003
1999	37490	0	37490	20.46	767027	1.74	20	1307203	1.74	0	0	2074230	55.33	600831
2000	38214	0	38214	21.15	808203	1.83	20	1399066	1.83	0	0	2207269	57.76	581243
SUM					7843317			10916967				18760283		8270354

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE B1 - RESOURCE RECOVERY, 40 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($)	21600	ALT VAR DISP COST (1993$/ton)	10.29
FACILITY CAPACITY(TONS/YR)	10464	FUEL COST, 1983 ($)	12000	ALT FIXED HAUL (1993$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	3250000	MAINT & SUPP COST, 1983 ($)	51000	ALT VAR HAUL (1993$/ton-mile)	0.15
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	17800	ALTERNATIVE DISP DIST (miles)	20
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1993
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	243000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/yr)	52320
ELECTRICAL COST, 1983 ($)	10700	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1982$/Mlb)	5.82
WATER COST, 1983 ($)	1900	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($)	1200	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh)	0
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	4	PRICE OF ELECTRICITY($/kwh)	0
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1993 $/ton)	7.34		

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	4211290	1146782
UNIFORM ANNUAL COST($)	553674	150772
UNIFORM ANNUAL COST($/TON)	52.91	14.41

OPERATION AND MAINTENANCE COSTS

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	10464	471	45.02	281	13	2	1	26	14	59	21	4186	8.40	35	0.43	4	7	460	44.00	399	0	532	50.88	532	10464	8.40	88	88
1987	10464	471	45.02	295	14	2	1	28	15	62	22	4186	8.82	37	0.44	4	7	484	46.26	427	0	528	50.46	480	10464	8.82	92	84
1988	10464	471	45.02	310	15	2	2	30	15	65	23	4186	9.27	39	0.45	4	8	509	48.63	457	0	523	49.98	432	10464	9.27	97	80
1989	10464	471	45.02	326	16	3	2	32	16	68	24	4186	9.73	41	0.46	4	8	535	51.13	489	0	517	49.42	389	10464	9.73	102	76
1990	10464	471	45.02	342	17	3	2	35	17	72	25	4186	10.22	43	0.47	4	8	562	53.76	523	0	510	48.78	349	10464	10.22	107	73
1991	10464	471	45.02	359	18	3	2	37	18	75	26	4186	10.73	45	0.48	4	8	591	56.52	560	0	503	48.04	312	10464	10.73	112	70
1992	10464	471	45.02	377	20	3	2	40	19	79	28	4186	11.26	47	0.49	4	8	622	59.43	599	0	494	47.21	279	10464	11.26	118	67
1993	10464	471	45.02	396	21	3	2	42	20	83	29	4186	17.63	74	0.23	20	19	689	65.85	641	0	519	49.62	266	10464	17.63	184	95
1994	10464	471	45.02	416	23	3	2	45	21	87	30	4186	18.14	76	0.24	20	20	723	69.09	686	0	508	48.57	237	10464	18.14	190	89
1995	10464	471	45.02	436	24	3	2	49	22	92	32	4186	18.68	78	0.25	20	21	759	72.49	734	0	496	47.39	210	10464	18.68	196	83
1996	10464	471	45.02	458	26	4	2	52	23	96	34	4186	19.25	81	0.25	20	21	796	76.08	785	0	482	46.06	186	10464	19.25	201	78
1997	10464	471	45.02	481	28	4	2	56	24	101	35	4186	19.85	83	0.26	20	22	836	79.85	840	0	467	44.58	164	10464	19.85	208	73
1998	10464	471	45.02	505	30	4	2	60	25	106	37	4186	20.47	86	0.27	20	23	877	83.82	899	0	449	42.94	143	10464	20.47	214	68
1999	10464	471	45.02	530	32	4	3	64	26	111	39	4186	21.13	88	0.28	20	24	921	88.01	962	0	430	41.10	125	10464	21.13	221	64
2000	10464	471	45.02	557	34	4	3	68	28	117	41	4186	21.82	91	0.29	20	24	967	92.41	1029	0	409	39.07	108	10464	21.82	228	60
SUM		7066												943			228	10331				7368		4211				1147

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE B1 - RESOURCE RECOVERY, 40 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1993
FACILITY CAPACITY(TONS/YR)	10464	ALT FIXED HAUL COST (1993$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1993$/ton-mile)	0.81
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1993$/ton)	7.34		
ALT LANDFILL VAR COST (1993$/ton)	10.29		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	10464	17616	8.40	148048	0.58	3	30588	0.58	6057	532380	717074	25.54	717074
1987	28804	10464	18340	8.82	161839	0.61	3	33438	0.61	6360	528036	729672	25.33	663338
1988	29527	10464	19063	9.27	176638	0.64	3	36495	0.64	6678	522971	742782	25.16	613869
1989	30251	10464	19787	9.73	192512	0.67	3	39775	0.67	7011	517114	756413	25.00	568304
1990	30975	10464	20511	10.22	209533	0.70	3	43292	0.70	7362	510388	770575	24.88	526313
1991	31699	10464	21235	10.73	227774	0.74	3	47061	0.74	7730	502709	785274	24.77	487593
1992	32423	10464	21959	11.26	247316	0.78	3	51098	0.78	8117	493986	800517	24.69	451871
1993	33147	10464	22683	17.63	399898	0.81	20	367462	0.81	8476	519225	1295061	39.07	664571
1994	33871	10464	23407	18.14	424703	0.85	20	398148	0.85	8900	508213	1339964	39.56	625103
1995	34595	10464	24131	18.68	450873	0.89	20	430984	0.89	9345	495842	1387045	40.09	588242
1996	35318	10464	24854	19.25	478497	0.94	20	466109	0.94	9812	481988	1436406	40.67	553797
1997	36042	10464	25578	19.85	507668	0.98	20	503668	0.98	10302	466515	1480154	41.29	521589
1998	36766	10464	26302	20.47	538484	1.03	20	543819	1.03	10818	449279	1542399	41.95	491456
1999	37490	10464	27026	21.13	571051	1.09	20	586725	1.09	11358	430121	1599255	42.66	463247
2000	38214	10464	27750	21.82	605479	1.14	20	632562	1.14	11926	408872	1658839	43.41	436824
SUM					5340313			4211225				17049428		8373192

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE B1 - RESOURCE RECOVERY, 40 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1993
FACILITY CAPACITY(TONS/YR)	10464	ALT FIXED HAUL COST (1993$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1993$/ton-mile)	1.30
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFI. ISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1993$/ton)	7.34		
ALT LANDFILL VAR COST (1993$/ton)	10.29		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	10464	17616	8.40	148048	0.93	3	48942	0.93	9691	532380	739061	26.32	739061
1987	28804	10464	18340	8.82	161839	0.97	3	53500	0.97	10175	528036	753550	26.16	685046
1988	29527	10464	19063	9.27	176638	1.02	3	58393	1.02	10684	522971	768686	26.03	635277
1989	30251	10464	19787	9.73	192512	1.07	3	63640	1.07	11218	517114	784485	25.93	589395
1990	30975	10464	20511	10.22	209533	1.13	3	69267	1.13	11779	510388	800967	25.86	547071
1991	31699	10464	21235	10.73	227774	1.18	3	75297	1.18	12368	502709	818148	25.81	508006
1992	32423	10464	21959	11.26	247316	1.24	3	81757	1.24	12986	493986	836045	25.79	471926
1993	33147	10464	22683	17.63	399898	1.30	20	589753	1.30	13603	519225	1522480	45.93	781273
1994	33871	10464	23407	18.14	424703	1.36	20	639003	1.36	14283	508213	1586203	46.83	739975
1995	34595	10464	24131	18.68	450873	1.43	20	691703	1.43	14998	495842	1653416	47.79	701210
1996	35318	10464	24854	19.25	478497	1.50	20	748076	1.50	15747	481988	1724309	48.82	664796
1997	36042	10464	25578	19.85	507668	1.58	20	808357	1.58	16535	466515	1799075	49.92	630565
1998	36766	10464	26302	20.47	538484	1.66	20	872796	1.66	17362	449279	1877920	51.08	598363
1999	37490	10464	27026	21.13	571051	1.74	20	941657	1.74	18230	430121	1961058	52.31	568049
2000	38214	10464	27750	21.82	605479	1.83	20	1015223	1.83	19141	408872	2048715	53.61	539491
SUM					5340313			6757365				19674118		9399503

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE CI - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($)	35000	ALT VAR DISP COST (1995$/ton)	11.35
FACILITY CAPACITY(TONS/YR)	16857	FUEL COST, 1983 ($)	12000	ALT FIXED HAUL (1995$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	5654000	MAINT & SUPP COST, 1983 ($)	82400	ALT VAR HAUL (1995$/ton-mile)	0.15
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	28700	ALTERNATIVE DISP DIST (miles)	20
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1995
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	243000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/yr)	84287
ELECTRICAL COST, 1983 ($)	17200	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1982$/Mlb)	5.82
WATER COST, 1983 ($)	3000	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($)	1800	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh)	0
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	4	PRICE OF ELECTRICITY($/kwh)	0
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1995 $/ton)	8.09		

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	5251993	1778051
UNIFORM ANNUAL COST($)	690499	233767
UNIFORM ANNUAL COST($/TON)	40.96	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL WASTE AMOUNT	LANDFILL UNIT	LANDFILL TOTAL	LANDFILL PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	16857	820	48.62	281	21	3	2	43	14	95	33	6743	8.40	57	0.43	4	12	562	33.32	643	0	738	43.79	738	16857	8.40	142	142
1987	16857	820	48.62	295	23	4	2	46	15	100	35	6743	8.82	60	0.44	4	12	591	35.04	688	0	722	42.84	657	16857	8.82	149	135
1988	16857	820	48.62	310	24	4	2	49	15	105	37	6743	9.27	62	0.45	4	12	621	36.85	736	0	705	41.80	582	16857	9.27	156	129
1989	16857	820	48.62	326	26	4	2	53	16	110	38	6743	9.73	66	0.46	4	12	653	38.76	788	0	685	40.65	515	16857	9.73	164	123
1990	16857	820	48.62	342	28	4	3	56	17	116	40	6743	10.22	69	0.47	4	13	687	40.77	843	0	664	39.39	454	16857	10.22	172	118
1991	16857	820	48.62	359	30	4	3	60	18	122	42	6743	10.73	72	0.48	4	13	723	42.89	902	0	641	38.01	398	16857	10.73	181	112
1992	16857	820	48.62	377	32	5	3	64	19	128	45	6743	11.26	76	0.49	4	13	761	45.12	965	0	615	36.49	347	16857	11.26	190	107
1993	16857	820	48.62	396	34	5	3	69	20	134	47	6743	11.83	80	0.50	4	14	800	47.47	1033	0	587	34.83	301	16857	11.83	199	102
1994	16857	820	48.62	416	36	5	3	74	21	141	49	6743	12.42	84	0.52	4	14	842	49.94	1105	0	557	33.02	260	16857	12.42	209	98
1995	16857	820	48.62	436	39	5	3	79	22	148	52	6743	19.44	131	0.23	20	31	946	56.10	1182	0	583	34.59	247	16857	19.44	328	139
1996	16857	820	48.62	458	41	6	3	84	23	155	54	6743	20.01	135	0.24	20	32	992	58.85	1265	0	547	32.44	211	16857	20.01	337	130
1997	16857	820	48.62	481	44	6	4	90	24	163	57	6743	20.60	139	0.25	20	33	1041	61.75	1353	0	507	30.08	178	16857	20.60	347	122
1998	16857	820	48.62	505	47	6	4	97	25	171	60	6743	21.23	143	0.25	20	34	1092	64.81	1448	0	464	27.51	148	16857	21.23	358	114
1999	16857	820	48.62	530	51	7	4	103	26	180	63	6743	21.89	148	0.26	20	35	1147	68.02	1550	0	417	24.72	121	16857	21.89	369	107
2000	16857	820	48.62	557	54	7	4	111	28	189	66	6743	22.58	152	0.27	20	37	1204	71.41	1658	0	365	21.67	96	16857	22.58	381	100
SUM		12293												1473			317	12662				8797		5252				1778

PART II
GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C1 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.58	3	19487	0.58	9757	738210	861774	30.69	861774
1987	28804	16857	11947	8.82	105423	0.61	3	21782	0.61	10245	722211	859661	29.85	781510
1988	29527	16857	12670	9.27	117402	0.64	3	24257	0.64	10757	704682	857017	29.02	708279
1989	30251	16857	13394	9.73	130314	0.67	3	26924	0.67	11295	685245	853779	28.22	641456
1990	30975	16857	14118	10.22	144225	0.70	3	29799	0.70	11860	663992	849875	27.44	580476
1991	31699	16857	14842	10.73	159201	0.74	3	32893	0.74	12453	640682	845229	26.66	524820
1992	32423	16857	15566	11.26	175314	0.78	3	36222	0.78	13075	615145	839756	25.90	474020
1993	33147	16857	16290	11.83	192640	0.81	3	39802	0.81	13729	587194	833365	25.14	427648
1994	33871	16857	17014	12.42	211260	0.86	3	43649	0.86	14416	556629	825954	24.39	385313
1995	34595	16857	17738	19.44	344819	0.90	20	319277	0.90	15171	583141	1262407	36.49	535384
1996	35318	16857	18461	20.01	369368	0.94	20	348922	0.94	15930	546762	1280981	36.27	493874
1997	36042	16857	19185	20.60	395283	0.99	20	380733	0.99	16726	507073	1299816	36.06	455578
1998	36766	16857	19909	21.23	422654	1.04	20	414854	1.04	17563	463806	1318876	35.87	420235
1999	37490	16857	20633	21.89	451576	1.09	20	451434	1.09	18441	416669	1338120	35.69	387606
2000	38214	16857	21357	22.58	482151	1.15	20	490636	1.15	19363	365349	1357499	35.52	357472
SUM					3795949			2680669				15484108		8035444

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C1 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.93	3	31180	0.93	15611	738210	879320	31.32	879320
1987	28804	16857	11947	8.82	105423	0.97	3	34851	0.97	16392	722211	878877	30.51	798979
1988	29527	16857	12670	9.27	117402	1.02	3	38810	1.02	17211	704602	878025	29.74	725641
1989	30251	16857	13394	9.73	130314	1.07	3	43079	1.07	18072	685245	876710	28.98	658685
1990	30975	16857	14118	10.22	144225	1.13	3	47678	1.13	18976	663992	874870	28.24	597548
1991	31699	16857	14842	10.73	159201	1.18	3	52628	1.18	19924	640682	872436	27.52	541714
1992	32423	16857	15566	11.26	175314	1.24	3	57955	1.24	20921	615145	869334	26.81	490717
1993	33147	16857	16290	11.83	192640	1.30	3	63683	1.30	21967	587194	865483	26.11	444130
1994	33871	16857	17014	12.42	211260	1.37	3	69838	1.37	23065	556629	860792	25.41	401566
1995	34595	16857	17738	19.44	344819	1.44	20	510843	1.44	24274	583141	1463076	42.29	620487
1996	35318	16857	18461	20.01	369368	1.51	20	558275	1.51	25488	546762	1499892	42.47	578273
1997	36042	16857	19185	20.60	395283	1.59	20	609173	1.59	26762	507073	1538292	42.68	539162
1998	36766	16857	19909	21.23	422654	1.67	20	663766	1.67	28100	463806	1578326	42.93	502903
1999	37490	16857	20633	21.89	451576	1.75	20	722295	1.75	29505	416669	1620045	43.21	469269
2000	38214	16857	21357	22.58	482151	1.84	20	785017	1.84	30981	365349	1663498	43.53	438051
SUM					379594			4289071				17218978		8686446

PART 1

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	16857
CAPITAL COST, 1983 DOLLARS	5000000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	243000
ELECTRICAL COST, 1983 ($)	17200
WATER COST, 1983 ($)	3000
SEWER COST, 1983 ($)	1800
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10

NATURAL GAS COST, 1983 ($)	35800
FUEL COST, 1983 ($)	12000
MAINT & SUPP COST, 1983 ($)	82400
INSURANCE COST, 1983 ($)	28700
FIXED DISPOSAL COST (1983 $/ton)	0.00
VAR DISPOSAL COST (1983 $/ton)	7.26
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.26
VAR HAUL COST (1983$/ton-mile)	0.15
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	4
ALT FIXED DISP COST (1995 $/ton)	8.09

ALT VAR DISP COST (1995$/ton)	11.35
ALT FIXED HAUL (1995$/ton-mile)	0.08
ALT VAR HAUL (1995$/ton-mile)	0.15
ALTERNATIVE DISP DIST (miles)	20
ALTERNATIVE DISP REQUIRED BY	1995
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/yr)	84287
PRICE OF STEAM(1982$/Mlb)	5.82
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh)	0
PRICE OF ELECTRICITY($/kwh)	0

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	4458854	1778851
UNIFORM ANNUAL COST($)	586222	233767
UNIFORM ANNUAL COST($/TON)	34.78	13.87

OPERATION AND MAINTENANCE COSTS

YEAR	WASTE TO RES REC FAC (tons)	CAPITAL COST total (1000$)	CAPITAL COST unit ($/ton)	LABOR COST (1000$)	ELEC COST (1000$)	WATER COST (1000$)	SEWER COST (1000$)	GAS COST (1000$)	FUEL COST (1000$)	SUPP COST (1000$)	INSUR COST (1000$)	RESIDUE DISPOSAL amount (tons)	RESIDUE DISPOSAL unit ($/ton)	RESIDUE DISPOSAL total (1000$)
1986	16857	725	42.99	281	21	3	2	43	14	95	33	6743	8.40	57
1987	16857	725	42.99	295	23	4	2	46	15	100	35	6743	8.82	60
1988	16857	725	42.99	310	24	4	2	49	15	105	37	6743	9.27	62
1989	16857	725	42.99	326	26	4	2	53	16	110	38	6743	9.73	66
1990	16857	725	42.99	342	28	4	3	56	17	116	40	6743	10.22	69
1991	16857	725	42.99	359	30	4	3	60	18	122	42	6743	10.73	72
1992	16857	725	42.99	377	32	5	3	64	19	128	45	6743	11.26	76
1993	16857	725	42.99	396	34	5	3	69	20	134	47	6743	11.83	80
1994	16857	725	42.99	416	36	5	3	74	21	141	49	6743	12.42	84
1995	16857	725	42.99	436	39	5	3	79	22	148	52	6743	19.44	131
1996	16857	725	42.99	458	41	6	3	84	23	155	54	6743	20.01	135
1997	16857	725	42.99	481	44	6	4	90	24	163	57	6743	20.60	139
1998	16857	725	42.99	505	47	6	4	97	25	171	60	6743	21.23	143
1999	16857	725	42.99	530	51	7	4	103	26	180	63	6743	21.89	148
2000	16857	725	42.99	557	54	7	4	111	28	189	66	6743	22.58	152
SUM		10871												1473

YEAR	RESIDUE DISPOSAL HAUL unit ($/ton-m)	RESIDUE DISPOSAL HAUL dist (miles)	RESIDUE DISPOSAL HAUL total (1000$)	TOTAL O & M total (1000$)	TOTAL O & M unit ($/ton)	REVENUES STEAM (1000$)	REVENUES ELEC (1000$)	RES REC NET COST (1000$)	TIP FEE ($)	RES REC PRESENT WORTH COST (1000$)	LANDFILL COSTS WASTE AMOUNT (1000$)	LANDFILL COSTS UNIT ($/ton)	LANDFILL COSTS TOTAL (1000$)	LANDFILL COSTS PRESENT WORTH (1000$)
1986	0.43	4	12	562	33.32	643	0	643	38.17	643	16857	8.40	142	142
1987	0.44	4	12	591	35.04	688	0	627	37.22	570	16857	8.82	149	135
1988	0.45	4	12	621	36.85	736	0	610	36.18	504	16857	9.27	156	129
1989	0.46	4	12	653	38.76	788	0	590	35.03	444	16857	9.73	164	123
1990	0.47	4	13	687	40.77	843	0	569	33.77	389	16857	10.22	172	118
1991	0.48	4	13	723	42.89	902	0	546	32.38	339	16857	10.73	181	112
1992	0.49	4	13	761	45.12	965	0	520	30.87	294	16857	11.26	190	107
1993	0.50	4	14	800	47.47	1033	0	492	29.21	253	16857	11.83	199	102
1994	0.52	4	14	842	49.94	1105	0	462	27.40	215	16857	12.42	209	98
1995	0.23	20	31	946	56.10	1182	0	488	28.97	207	16857	19.44	328	139
1996	0.24	20	32	992	58.85	1265	0	452	26.81	174	16857	20.01	337	130
1997	0.25	20	33	1041	61.75	1353	0	412	24.46	145	16857	20.60	347	122
1998	0.25	20	34	1092	64.81	1448	0	369	21.89	118	16857	21.23	358	114
1999	0.26	20	35	1147	68.02	1550	0	322	19.09	93	16857	21.89	369	107
2000	0.27	20	37	1204	71.41	1658	0	271	16.05	71	16857	22.58	381	100
SUM			317	12662				7375		4459				1778

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	16857
LANDFILL FIXED COST (1983$/ton)	0.00
LANDFILL VAR COST (1983$/ton)	7.26
LANDFILL ESCALATION RATE(%)	5
LF FIXED HAUL COST(1983$/ton-mile)	0.00
LF VAR HAUL COST (1983$/ton-mile)	0.50
LANDFILL HAUL ESCALATION RATE(%)	5
LANDFILL DISTANCE (MILES)	3
ALT LANDFILL FIXED COST (1995$/ton)	8.09
ALT LANDFILL VAR COST (1995$/ton)	11.35
ALTERNATE LANDFILL REQUIRED BY	1995
ALT FIXED HAUL COST (1995$/ton-mile)	0.00
ALT VAR HAUL COST (1995$/ton-mile)	0.90
ALTERNATE LANDFILL DISTANCE (miles)	20
RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
RECOVERY HAUL ESCALATION RATE(%)	5
RECOVERY HAUL DISTANCE(miles)	1
PRESENT WORTH DISCOUNT RATE (%)	10

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.58	3	19487	0.58	9757	643413	766977	27.31	766977
1987	28804	16857	11947	8.82	105423	0.61	3	21782	0.61	10245	627414	764864	26.55	695331
1988	29527	16857	12670	9.27	117402	0.64	3	24257	0.64	10757	609805	762220	25.81	629934
1989	30251	16857	13394	9.73	130314	0.67	3	26924	0.67	11295	590448	758981	25.09	570234
1990	30975	16857	14118	10.22	144225	0.70	3	29799	0.70	11860	569194	755078	24.38	515728
1991	31699	16857	14842	10.73	159201	0.74	3	32893	0.74	12453	545885	750431	23.67	465959
1992	32423	16857	15566	11.26	175314	0.78	3	36222	0.78	13075	520348	744959	22.98	420510
1993	33147	16857	16290	11.83	192640	0.81	3	39802	0.81	13729	492397	738568	22.28	379002
1994	33871	16857	17014	12.42	211260	0.86	3	43649	0.86	14416	461832	731156	21.59	341090
1995	34595	16857	17738	19.44	344819	0.90	20	319277	0.:	15171	488343	1167610	33.75	495181
1996	35318	16857	18461	20.01	369368	0.94	20	348922	0.94	15930	451964	1186184	33.59	457325
1997	36042	16857	19185	20.60	395283	0.99	20	380733	0.99	16726	412276	1205019	33.43	422352
1998	36766	16857	19909	21.23	422654	1.04	20	414854	1.04	17563	369009	1224079	33.29	390029
1999	37490	16857	20633	21.89	451576	1.09	20	451434	1.09	18441	321872	1243323	33.16	360146
2000	38214	16857	21357	22.58	482151	1.15	20	490636	1.15	19363	270552	1262702	33.04	332509
SUM					3795949			2680669				14062150		7242306

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.93	3	31180	0.93	15611	643413	784523	27.94	784523
1987	28804	16857	11947	8.82	105423	0.97	3	34851	0.97	16392	627414	784080	27.22	712800
1988	29527	16857	12670	9.27	117402	1.02	3	38810	1.02	17211	609805	783228	26.53	647296
1989	30251	16857	13394	9.73	130314	1.07	3	43079	1.07	18072	590448	781913	25.85	587463
1990	30975	16857	14118	10.22	144225	1.13	3	47678	1.13	18976	569194	780072	25.18	532800
1991	31699	16857	14842	10.73	159201	1.18	3	52628	1.18	19924	545885	777639	24.53	482852
1992	32423	16857	15566	11.26	175314	1.24	3	57955	1.24	20921	520348	774537	23.89	437206
1993	33147	16857	16290	11.83	192640	1.30	3	63683	1.30	21967	492397	770686	23.25	395484
1994	33871	16857	17014	12.42	211260	1.37	3	69838	1.37	23065	461832	765995	22.62	357342
1995	34595	16857	17738	19.44	344819	1.44	20	510843	1.44	24274	488343	1368279	39.55	580284
1996	35318	16857	18461	20.01	369368	1.51	20	558275	1.51	25488	451964	1405095	39.78	541725
1997	36042	16857	19185	20.60	395283	1.59	20	609173	1.59	26762	412276	1443495	40.05	505936
1998	36766	16857	19909	21.23	422654	1.67	20	663766	1.67	28100	369009	1483529	40.35	472698
1999	37490	16857	20633	21.89	451576	1.75	20	722295	1.75	29505	321872	1525248	40.68	441810
2000	38214	16857	21357	22.58	482151	1.84	20	785017	1.84	30981	270552	1568701	41.05	413088
SUM					3795549			4289071				15797820		7893307

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C3 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	16857
CAPITAL COST, 1983 DOLLARS	5654000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	221000
ELECTRICAL COST, 1983 ($)	16000
WATER COST, 1983 ($)	2800
SEWER COST, 1983 ($)	1600
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10

NATURAL GAS COST, 1983 ($)	32000
FUEL COST, 1983 ($)	11000
MAINT & SUPP COST, 1983 ($)	75000
INSURANCE COST, 1983 ($)	26000
FIXED DISPOSAL COST (1983 $/ton)	0.00
VAR DISPOSAL COST (1983 $/ton)	7.26
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.26
VAR HAUL COST (1983$/ton-mile)	0.15
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	4
ALT FIXED DISP COST (1995 $/ton)	8.09

ALT VAR DISP COST (1995$/ton)	11.35
ALT FIXED HAUL (1995$/ton-mile)	0.08
ALT VAR HAUL (1995$/ton-mile)	0.15
ALTERNATIVE DISP DIST (miles)	20
ALTERNATIVE DISP REQUIRED BY	1995
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/yr)	84287
PRICE OF STEAM(1982$/Mlb)	5.82
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh)	0
PRICE OF ELECTRICITY($/kwh)	0

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	4759377	1778051
UNIFORM ANNUAL COST($)	625733	233767
UNIFORM ANNUAL COST($/TON)	37.12	13.87

YEAR	WASTE TO RES REC FAC (tons)	CAPITAL COST total (1000$)	CAPITAL COST unit ($/ton)	OPERATION AND MAINTENANCE COSTS: LABOR COST (1000$)	ELEC COST (1000$)	WATER COST (1000$)	SEWER COST (1000$)	GAS COST (1000$)	FUEL COST (1000$)	SUPP COST (1000$)	INSUR COST (1000$)
1986	16857	820	48.62	256	20	3	2	39	13	87	30
1987	16857	820	48.62	269	21	3	2	42	13	91	32
1988	16857	820	48.62	282	22	4	2	45	14	96	33
1989	16857	820	48.62	296	24	4	2	48	15	101	35
1990	16857	820	48.62	311	26	4	2	51	15	106	37
1991	16857	820	48.62	327	27	4	2	55	16	111	38
1992	16857	820	48.62	343	29	4	2	59	17	116	40
1993	16857	820	48.62	360	31	5	3	63	18	122	42
1994	16857	820	48.62	378	34	5	3	67	19	128	44
1995	16857	820	48.62	397	36	5	3	72	20	135	47
1996	16857	820	48.62	417	39	5	3	77	21	141	49
1997	16857	820	48.62	438	41	6	3	83	22	148	51
1998	16857	820	48.62	459	44	6	3	88	23	156	54
1999	16857	820	48.62	482	47	6	3	94	24	164	57
2000	16857	820	48.62	507	51	6	4	101	25	172	60
SUM		12293									

YEAR	RESIDUE DISPOSAL amount (tons)	RESIDUE DISPOSAL unit ($/ton)	RESIDUE DISPOSAL total (1000$)	RESIDUE DISPOSAL HAUL unit ($/ton-m)	RESIDUE DISPOSAL HAUL dist (miles)	RESIDUE DISPOSAL HAUL total (1000$)	TOTAL O & M total (1000$)	TOTAL O & M unit ($/ton)	REVENUES STEAM (1000$)	REVENUES ELEC (1000$)	RES REC NET COST (1000$)	TIP FEE ($)	RES REC PRESENT WORTH COST (1000$)	LANDFILL COSTS WASTE AMOUNT (1000$)	UNIT ($/ton)	TOTAL (1000$)	PRESENT WORTH (1000$)
1986	6743	8.40	57	0.43	4	12	518	30.71	643	0	694	41.19	694	16857	8.40	142	142
1987	6743	8.82	60	0.44	4	12	544	32.30	688	0	676	40.10	615	16857	8.82	149	135
1988	6743	9.27	62	0.45	4	12	573	33.97	736	0	656	38.91	542	16857	9.27	156	129
1989	6743	9.73	66	0.46	4	12	602	35.73	788	0	634	37.61	476	16857	9.73	164	123
1990	6743	10.22	69	0.47	4	13	633	37.58	843	0	610	36.19	417	16857	10.22	172	118
1991	6743	10.73	72	0.48	4	13	666	39.53	902	0	584	34.64	363	16857	10.73	181	112
1992	6743	11.26	76	0.49	4	13	701	41.58	965	0	555	32.95	314	16857	11.26	190	107
1993	6743	11.83	80	0.50	4	14	737	43.74	1033	0	524	31.11	269	16857	11.83	199	102
1994	6743	12.42	84	0.52	4	14	776	46.02	1105	0	490	29.10	229	16857	12.42	209	98
1995	6743	19.44	131	0.23	20	31	876	51.97	1182	0	514	30.46	218	16857	19.44	328	139
1996	6743	20.01	135	0.24	20	32	919	54.51	1265	0	473	28.09	183	16857	20.01	337	130
1997	6743	20.60	139	0.25	20	33	964	57.18	1353	0	430	25.50	151	16857	20.60	347	122
1998	6743	21.23	143	0.25	20	34	1011	59.99	1448	0	383	22.70	122	16857	21.23	358	114
1999	6743	21.89	148	0.26	20	35	1061	62.95	1550	0	331	19.64	96	16857	21.89	369	107
2000	6743	22.58	152	0.27	20	37	1114	66.07	1658	0	275	16.33	72	16857	22.58	381	100
SUM			1473			317	11696				7831		4759				1778

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C3 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.58	3	19487	0.58	9757	694284	817848	29.13	817848
1987	28804	16857	11947	8.82	105423	0.61	3	21782	0.61	10245	675987	813436	28.24	739487
1988	29527	16857	12670	9.27	117402	0.64	3	24257	0.64	10757	655956	808371	27.38	668075
1989	30251	16857	13394	9.73	130314	0.67	3	26924	0.67	11295	634049	802582	26.53	602992
1990	30975	16857	14118	10.22	144225	0.70	3	29799	0.70	11860	610109	795993	25.70	543674
1991	31699	16857	14842	10.73	159201	0.74	3	32893	0.74	12453	583971	788518	24.88	489607
1992	32423	16857	15566	11.26	175314	0.78	3	36222	0.78	13075	555454	780065	24.06	440326
1993	33147	16857	16290	11.83	192640	0.81	3	39802	0.81	13729	524364	770535	23.25	395406
1994	33871	16857	17014	12.42	211260	0.86	3	43649	0.86	14416	490492	759817	22.43	354460
1995	34595	16857	17738	19.44	344819	0.90	20	319277	0.90	15171	513520	1192787	34.48	505858
1996	35318	16857	18461	20.01	369368	0.94	20	348922	0.94	15930	473471	1207691	34.19	465617
1997	36842	16857	19185	20.60	395283	0.99	20	380733	0.99	16726	429916	1222659	33.92	428534
1998	36766	16857	19909	21.23	422654	1.04	20	414854	1.04	17563	382574	1237644	33.66	394352
1999	37490	16857	20633	21.89	451576	1.09	20	451434	1.09	18441	331143	1252595	33.41	362932
2000	38214	16857	21357	22.58	482151	1.15	20	490636	1.15	19363	275299	1267449	33.17	333759
SUM					3795949			2680669				14517989		7542829

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C3 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.93	3	31180	0.93	15611	694284	835395	29.75	835395
1987	28804	16857	11947	8.82	105423	0.97	3	34851	0.97	16392	675987	832652	28.91	756956
1988	29527	16857	12670	9.27	117402	1.02	3	38810	1.02	17211	655956	829379	28.09	685437
1989	30251	16857	13394	9.73	130314	1.07	3	43079	1.07	18072	634049	825514	27.29	620221
1990	30975	16857	14118	10.22	144225	1.13	3	47678	1.13	18976	610109	820988	26.50	560746
1991	31699	16857	14842	10.73	159201	1.18	3	52628	1.18	19924	583971	815725	25.73	506501
1992	32423	16857	15566	11.26	175314	1.24	3	57955	1.24	20921	555454	809643	24.97	457023
1993	33147	16857	16290	11.83	192640	1.30	3	63683	1.30	21967	524364	802653	24.22	411888
1994	33871	16857	17014	12.42	211260	1.37	3	69838	1.37	23065	490492	794656	23.46	370713
1995	34595	16857	17738	19.44	344819	1.44	20	510843	1.44	24274	513520	1393455	40.28	590961
1996	35318	16857	18461	20.01	369368	1.51	20	558275	1.51	25488	473471	1426602	40.39	550017
1997	36042	16857	19185	20.60	395283	1.59	20	609173	1.59	26762	429916	1461134	40.54	512119
1998	36766	16857	19909	21.23	422654	1.67	20	663766	1.67	28100	382574	1497094	40.72	477020
1999	37490	16857	20633	21.89	451576	1.75	20	722295	1.75	29505	331143	1534520	40.93	444496
2000	38214	16857	21357	22.58	482151	1.84	20	785017	1.84	30981	275299	1573448	41.17	414338
SUM					3795949			4289071				16252858		8193830

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C4 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($)	32000	ALT VAR DISP COST (1995$/ton)	11.35
FACILITY CAPACITY(TONS/YR)	16857	FUEL COST, 1983 ($)	11000	ALT FIXED HAUL (1995$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	5000000	MAINT & SUPP COST, 1983 ($)	75000	ALT VAR HAUL (1995$/ton-mile)	0.15
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	26000	ALTERNATIVE DISP DIST (miles)	20
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1995
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	221000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/yr)	84287
ELECTRICAL COST, 1983 ($)	16000	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1982$/Mlb)	5.82
WATER COST, 1983 ($)	2800	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($)	1600	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh)	0
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	4	PRICE OF ELECTRICITY($/kwh)	0
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1995 $/ton)	8.09		

************************** SUMMARY **************************

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	3966238	1778051
UNIFORM ANNUAL COST($)	521456	233767
UNIFORM ANNUAL COST($/TON)	30.93	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	16857	725	42.99	256	20	3	2	39	13	87	30	6743	8.40	57	0.43	4	12	518	30.71	643	0	599	35.56	599	16857	8.40	142	142
1987	16857	725	42.99	269	21	3	2	42	13	91	32	6743	8.82	60	0.44	4	12	544	32.30	688	0	581	34.48	528	16857	8.82	149	135
1988	16857	725	42.99	282	22	4	2	45	14	96	33	6743	9.27	62	0.45	4	12	573	33.97	736	0	561	33.29	464	16857	9.27	156	129
1989	16857	725	42.99	296	24	4	2	48	15	101	35	6743	9.73	66	0.46	4	12	602	35.73	788	0	539	31.99	405	16857	9.73	164	123
1990	16857	725	42.99	311	26	4	2	51	15	106	37	6743	10.22	69	0.47	4	13	633	37.58	843	0	515	30.57	352	16857	10.22	172	118
1991	16857	725	42.99	327	27	4	2	55	16	111	38	6743	10.73	72	0.48	4	13	666	39.53	902	0	489	29.02	304	16857	10.73	181	112
1992	16857	725	42.99	343	29	4	2	59	17	116	40	6743	11.26	76	0.49	4	13	701	41.58	965	0	461	27.33	260	16857	11.26	190	107
1993	16857	725	42.99	360	31	5	3	63	18	122	42	6743	11.83	80	0.50	4	14	737	43.74	1033	0	430	25.48	220	16857	11.83	199	102
1994	16857	725	42.99	378	34	5	3	67	19	128	44	6743	12.42	84	0.52	4	14	776	46.02	1105	0	396	23.47	185	16857	12.42	209	98
1995	16857	725	42.99	397	36	5	3	72	20	135	47	6743	19.44	131	0.23	20	31	876	51.97	1182	0	419	24.84	178	16857	19.44	328	139
1996	16857	725	42.99	417	39	5	3	77	21	141	49	6743	20.01	135	0.24	20	32	919	54.51	1265	0	379	22.46	146	16857	20.01	337	130
1997	16857	725	42.99	438	41	6	3	83	22	148	51	6743	20.60	139	0.25	20	33	964	57.18	1353	0	335	19.88	117	16857	20.60	347	122
1998	16857	725	42.99	459	44	6	3	88	23	156	54	6743	21.23	143	0.25	20	34	1011	59.99	1448	0	288	17.07	92	16857	21.23	358	114
1999	16857	725	42.99	482	47	6	3	94	24	164	57	6743	21.89	148	0.26	20	35	1061	62.95	1550	0	236	14.02	68	16857	21.89	369	107
2000	16857	725	42.99	507	51	6	4	101	25	172	60	6743	22.58	152	0.27	20	37	1114	66.07	1658	0	181	10.71	48	16857	22.58	381	100
SUM		10871												1473			317	11696				6409		3966				1778

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C4 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.58	3	19487	0.58	9757	599487	723051	25.75	723051
1987	28804	16857	11947	8.82	105423	0.61	3	21782	0.61	10245	581189	718639	24.95	653308
1988	29527	16857	12670	9.27	117402	0.64	3	24257	0.64	10757	561159	713574	24.17	589731
1989	30251	16857	13394	9.73	130314	0.67	3	26924	0.67	11295	539251	707785	23.40	531769
1990	30975	16857	14118	10.22	144225	0.70	3	29799	0.70	11860	515312	701195	22.64	478926
1991	31699	16857	14842	10.73	159201	0.74	3	32893	0.74	12453	489174	693720	21.88	430746
1992	32423	16857	15566	11.26	175314	0.78	3	36222	0.78	13075	460657	685268	21.14	386816
1993	33147	16857	16290	11.83	192640	0.81	3	39802	0.81	13729	429567	675738	20.39	346760
1994	33871	16857	17014	12.42	211260	0.86	3	43649	0.86	14416	395695	665020	19.63	310237
1995	34595	16857	17738	19.44	344819	0.90	20	319277	0.90	15171	418723	1097990	31.74	465655
1996	35318	16857	18461	20.01	369368	0.94	20	348922	0.94	15930	378674	1112893	31.51	429069
1997	36042	16857	19185	20.60	395283	0.99	20	380733	0.99	16726	335119	1127861	31.29	395309
1998	36766	16857	19909	21.23	422654	1.04	20	414854	1.04	17563	287777	1142847	31.08	364146
1999	37490	16857	20633	21.89	451576	1.09	20	451434	1.09	18441	236346	1157798	30.88	335373
2000	38214	16857	21357	22.58	482151	1.15	20	490636	1.15	19363	180502	1172652	30.69	308796
SUM					3795949			2680669				13096031		6749690

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C4 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	16857	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	16857	11223	8.40	94319	0.93	3	31180	0.93	15611	599487	740598	26.37	740598
1987	28804	16857	11947	8.82	105423	0.97	3	34851	0.97	16392	581189	737855	25.62	670777
1988	29527	16857	12670	9.27	117402	1.02	3	38810	1.02	17211	561159	734582	24.88	607093
1989	30251	16857	13394	9.73	130314	1.07	3	43079	1.07	18072	539251	730717	24.15	548998
1990	30975	16857	14118	10.22	144225	1.13	3	47678	1.13	18976	515312	726190	23.44	495998
1991	31699	16857	14842	10.73	159201	1.18	3	52628	1.18	19924	489174	720928	22.74	447639
1992	32423	16857	15566	11.26	175314	1.24	3	57955	1.24	20921	460657	714846	22.05	403512
1993	33147	16857	16290	11.83	192640	1.30	3	63683	1.30	21967	429567	707856	21.36	363242
1994	33871	16857	17014	12.42	211260	1.37	3	69838	1.37	23065	395695	699858	20.66	326489
1995	34595	16857	17738	19.44	344819	1.44	20	510843	1.44	24274	418723	1298658	37.54	550758
1996	35318	16857	18461	20.01	369368	1.51	20	558275	1.51	25488	378674	1331804	37.71	513468
1997	36042	16857	19185	20.60	395283	1.59	20	609173	1.59	26762	335119	1366337	37.91	478893
1998	36766	16857	19909	21.23	422654	1.67	20	663766	1.67	28100	287777	1402297	38.14	446815
1999	37490	16857	20633	21.89	451576	1.75	20	722295	1.75	29505	236346	1439723	38.40	417036
2000	38214	16857	21357	22.58	482151	1.84	20	785017	1.84	30981	180502	1478651	38.69	389375
SUM					3795949			4289071				14830900		7400691

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D1 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($)	38000	ALT VAR DISP COST (1995$/ton)	11.35
FACILITY CAPACITY(TONS/YR)	18253	FUEL COST, 1983 ($)	13000	ALT FIXED HAUL (1995$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	6511000	MAINT & SUPP COST, 1983 ($)	104000	ALT VAR HAUL (1995$/ton-mile)	0.15
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	31000	ALTERNATIVE DISP DIST (miles)	20
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1995
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	243000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/yr)	84287
ELECTRICAL COST, 1983 ($)	26000	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1982$/Mlb)	5.82
WATER COST, 1983 ($)	3300	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($)	2000	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh)	2281625
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	4	PRICE OF ELECTRICITY($/kwh)	0.05
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1995 $/ton)	8.09		

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	5005789	1925299
UNIFORM ANNUAL COST($)	658130	253126
UNIFORM ANNUAL COST($/TON)	36.06	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL WASTE AMOUNT	LANDFILL UNIT	LANDFILL TOTAL	LANDFILL PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	18253	944	51.70	281	32	4	2	47	15	120	36	7301	8.40	61	0.43	4	13	611	33.48	643	150	762	41.77	762	18253	8.40	153	153
1987	18253	944	51.70	295	34	4	2	50	16	126	38	7301	8.82	64	0.44	4	13	643	35.22	688	160	739	40.47	672	18253	8.82	161	146
1988	18253	944	51.70	310	36	4	3	53	17	133	40	7301	9.27	68	0.45	4	13	676	37.06	736	171	713	39.05	589	18253	9.27	169	140
1989	18253	944	51.70	326	39	4	3	57	17	139	42	7301	9.73	71	0.46	4	13	712	38.99	788	183	684	37.50	514	18253	9.73	178	133
1990	18253	944	51.70	342	42	5	3	61	18	146	44	7301	10.22	75	0.47	4	14	749	41.02	843	196	654	35.81	446	18253	10.22	186	127
1991	18253	944	51.70	359	45	5	3	65	19	154	46	7301	10.73	78	0.48	4	14	788	43.16	902	210	620	33.97	385	18253	10.73	196	122
1992	18253	944	51.70	377	48	5	3	70	20	161	48	7301	11.26	82	0.49	4	14	829	45.42	965	224	583	31.96	329	18253	11.26	206	116
1993	18253	944	51.70	396	51	5	3	75	21	169	50	7301	11.83	86	0.50	4	15	872	47.80	1033	240	544	29.78	279	18253	11.83	216	111
1994	18253	944	51.70	416	55	6	3	80	22	178	53	7301	12.42	91	0.52	4	15	918	50.31	1105	257	500	27.41	233	18253	12.42	227	106
1995	18253	944	51.70	436	59	6	4	86	23	187	56	7301	19.44	142	0.23	20	34	1031	56.50	1182	275	518	28.38	220	18253	19.44	355	150
1996	18253	944	51.70	458	63	6	4	92	25	196	58	7301	20.01	146	0.24	20	35	1082	59.29	1265	294	467	25.58	180	18253	20.01	365	141
1997	18253	944	51.70	481	67	7	4	98	26	206	61	7301	20.60	150	0.25	20	36	1136	62.23	1353	315	412	22.54	144	18253	20.60	376	132
1998	18253	944	51.70	505	72	7	4	105	27	216	64	7301	21.23	155	0.25	20	37	1192	65.33	1448	337	351	19.25	112	18253	21.23	387	123
1999	18253	944	51.70	530	77	7	4	112	28	227	68	7301	21.89	160	0.26	20	38	1252	68.60	1550	360	286	15.67	83	18253	21.89	399	116
2000	18253	944	51.70	557	82	8	5	120	30	238	71	7301	22.58	165	0.27	20	40	1315	72.04	1658	386	215	11.79	57	18253	22.58	412	109
SUM		14157												1595			343	13808				8048		5006				1925

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D1 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	0.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.58	3	17063	0.58	10565	762416	872631	31.08	872631
1987	28804	18253	10551	8.82	93104	0.61	3	19236	0.61	11093	738685	862119	29.93	783745
1988	29527	18253	11274	9.27	104466	0.64	3	21584	0.64	11648	712769	850467	28.80	702866
1989	30251	18253	11998	9.73	116733	0.67	3	24118	0.67	12230	684487	837568	27.69	629277
1990	30975	18253	12722	10.22	129964	0.70	3	26852	0.70	12842	653646	823304	26.58	562328
1991	31699	18253	13446	10.73	144227	0.74	3	29799	0.74	13484	620038	807548	25.48	501424
1992	32423	18253	14170	11.26	159591	0.78	3	32973	0.78	14158	583439	790162	24.37	446026
1993	33147	18253	14894	11.83	176131	0.81	3	36391	0.81	14866	543608	770996	23.26	395643
1994	33871	18253	15618	12.42	193926	0.86	3	40067	0.86	15609	500285	749888	22.14	349828
1995	34595	18253	16342	19.44	317680	0.90	20	294149	0.90	16428	518059	1146316	33.14	486150
1996	35318	18253	17065	20.01	341437	0.94	20	322537	0.94	17249	466977	1148201	32.51	442681
1997	36042	18253	17789	20.60	366521	0.99	20	353030	0.99	18112	411504	1149166	31.88	402776
1998	36766	18253	18513	21.23	393018	1.04	20	385765	1.04	19017	351290	1149090	31.25	366136
1999	37490	18253	19237	21.89	421023	1.09	20	420891	1.09	19968	285961	1147843	30.62	332489
2000	38214	18253	19961	22.58	450635	1.15	20	458565	1.15	20966	215113	1145280	29.97	301588
SUM					3491044			2483021				14250579		7575586

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D1 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.93	3	27301	0.93	16904	762416	889208	31.67	889208
1987	28804	18253	10551	8.82	93104	0.97	3	30778	0.97	17749	738685	880317	30.56	800288
1988	29527	18253	11274	9.27	104466	1.02	3	34534	1.02	18637	712769	870407	29.48	719344
1989	30251	18253	11998	9.73	116733	1.07	3	38589	1.07	19569	684487	859377	28.41	645663
1990	30975	18253	12722	10.22	129964	1.13	3	42963	1.13	20547	653646	847120	27.35	578594
1991	31699	18253	13446	10.73	144227	1.18	3	47678	1.18	21574	620038	833518	26.29	517549
1992	32423	18253	14170	11.26	159591	1.24	3	52757	1.24	22653	583439	818441	25.24	461988
1993	33147	18253	14894	11.83	176131	1.30	3	58225	1.30	23786	543608	801750	24.19	411425
1994	33871	18253	15618	12.42	193926	1.37	3	64108	1.37	24975	500285	783294	23.13	365413
1995	34595	18253	16342	19.44	317680	1.44	20	470638	1.44	26284	518059	1332661	38.52	565179
1996	35318	18253	17065	20.01	341437	1.51	20	516060	1.51	27599	466977	1352073	38.28	521283
1997	36042	18253	17789	20.60	366521	1.59	20	564848	1.59	28978	411504	1371851	38.06	480825
1998	36766	18253	18513	21.23	393018	1.67	20	617224	1.67	30427	351290	1391959	37.86	443521
1999	37490	18253	19237	21.89	421023	1.75	20	673426	1.75	31949	285961	1412358	37.67	409110
2000	38214	18253	19961	22.58	450635	1.84	20	733705	1.84	33546	215113	1432999	37.50	377354
SUM					3491044			3972834				15877334		8186743

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($)	38000	ALT VAR DISP COST (1995$/ton)	11.35
FACILITY CAPACITY(TONS/YR)	18253	FUEL COST, 1983 ($)	13000	ALT FIXED HAUL (1995$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	6311000	MAINT & SUPP COST, 1983 ($)	104000	ALT VAR HAUL (1995$/ton-mile)	0.15
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	31000	ALTERNATIVE DISP DIST (miles)	20
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1995
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	243000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/yr)	84287
ELECTRICAL COST, 1983 ($)	26000	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1982$/Mlb)	5.82
WATER COST, 1983 ($)	3300	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($)	2000	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh)	2281625
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	4	PRICE OF ELECTRICITY($/kwh)	0.06
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1995 $/ton)	8.09		

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	4633481	1925299
UNIFORM ANNUAL COST($)	609181	253126
UNIFORM ANNUAL COST($/TON)	33.37	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	18253	944	51.70	281	32	4	2	47	15	120	36	7301	8.40	61	0.43	4	13	611	33.48	643	179	733	40.13	733	18253	8.40	153	153
1987	18253	944	51.70	295	34	4	2	50	16	126	38	7301	8.82	64	0.44	4	13	643	35.22	688	192	707	38.72	642	18253	8.82	161	146
1988	18253	944	51.70	310	36	4	3	53	17	133	40	7301	9.27	68	0.45	4	13	676	37.06	736	205	679	37.17	561	18253	9.27	169	140
1989	18253	944	51.70	326	39	4	3	57	17	139	42	7301	9.73	71	0.46	4	13	712	38.99	788	220	648	35.49	487	18253	9.73	178	133
1990	18253	944	51.70	342	42	5	3	61	18	146	44	7301	10.22	75	0.47	4	14	749	41.02	843	235	614	33.66	420	18253	10.22	186	127
1991	18253	944	51.70	359	45	5	3	65	19	154	46	7301	10.73	78	0.48	4	14	788	43.16	902	252	578	31.67	359	18253	10.73	196	122
1992	18253	944	51.70	377	48	5	3	70	20	161	48	7301	11.26	82	0.49	4	14	829	45.42	965	263	539	29.51	304	18253	11.26	206	116
1993	18253	944	51.70	396	51	5	3	75	21	169	50	7301	11.83	86	0.50	4	15	872	47.80	1033	288	496	27.15	254	18253	11.83	216	111
1994	18253	944	51.70	416	55	6	3	80	22	178	53	7301	12.42	91	0.52	4	15	918	50.31	1105	308	449	24.59	209	18253	12.42	227	106
1995	18253	944	51.70	436	59	6	4	86	23	187	56	7301	19.44	142	0.23	20	34	1031	56.50	1182	330	463	25.37	196	18253	19.44	355	150
1996	18253	944	51.70	458	63	6	4	92	25	196	58	7301	20.01	146	0.24	20	35	1082	59.29	1265	353	408	22.36	157	18253	20.01	365	141
1997	18253	944	51.70	481	67	7	4	98	26	206	61	7301	20.60	150	0.25	20	36	1136	62.23	1353	378	349	19.10	122	18253	20.60	376	132
1998	18253	944	51.70	505	72	7	4	105	27	216	64	7301	21.23	155	0.25	20	37	1192	65.33	1448	404	284	15.56	90	18253	21.23	387	123
1999	18253	944	51.70	530	77	7	4	112	28	227	68	7301	21.89	160	0.26	20	38	1252	68.60	1550	432	214	11.72	62	18253	21.89	399	116
2000	18253	944	51.70	557	82	8	5	120	30	238	71	7301	22.58	165	0.27	20	40	1315	72.04	1658	463	138	7.56	36	18253	22.58	412	109
SUM		14157												1595			343	13808				7297		4633				1925

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.58	3	17063	0.58	10565	732508	842723	30.01	842723
1987	28804	18253	10551	8.82	93104	0.61	3	19236	0.61	11093	706684	830118	28.82	754653
1988	29527	18253	11274	9.27	104466	0.64	3	21584	0.64	11648	678528	816226	27.64	674567
1989	30251	18253	11998	9.73	116733	0.67	3	24118	0.67	12230	647849	800930	26.48	601751
1990	30975	18253	12722	10.22	129964	0.70	3	26852	0.70	12842	614443	784101	25.31	535552
1991	31699	18253	13446	10.73	144227	0.74	3	29799	0.74	13484	578091	765601	24.15	475378
1992	32423	18253	14170	11.26	159591	0.78	3	32973	0.78	14158	538556	745279	22.99	420690
1993	33147	18253	14894	11.83	176131	0.81	3	36391	0.81	14866	495584	722971	21.81	370999
1994	33871	18253	15618	12.42	193926	0.86	3	40067	0.86	15609	448899	698502	20.62	325856
1995	34595	18253	16342	19.44	317680	0.90	20	294149	0.90	16428	463075	1091332	31.55	462831
1996	35318	18253	17065	20.01	341437	0.94	20	322537	0.94	17249	408145	1089369	30.84	419999
1997	36042	18253	17789	20.60	366521	0.99	20	353030	0.99	18112	348553	1086215	30.14	380712
1998	36766	18253	18513	21.23	393018	1.04	20	385765	1.04	19017	283932	1081733	29.42	344673
1999	37490	18253	19237	21.89	421023	1.09	20	420891	1.09	19968	213888	1075771	28.69	311612
2000	38214	18253	19961	22.58	450635	1.15	20	458565	1.15	20966	137996	1068163	27.95	281281
SUM					3491044			2483021				13499034		7283277

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D2 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-· .	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.93	3	27301	0.93	16904	732588	859300	30.60	859300
1987	28804	18253	10551	8.82	93104	0.97	3	30778	0.97	17749	706684	848316	29.45	771196
1988	29527	18253	11274	9.27	104466	1.02	3	34534	1.02	18637	678528	836165	28.32	691046
1989	30251	18253	11998	9.73	116733	1.07	3	38589	1.07	19569	647849	822739	27.20	618136
1990	30975	18253	12722	10.22	129964	1.13	3	42963	1.13	20547	614443	807918	26.08	551819
1991	31699	18253	13446	10.73	144227	1.18	3	47678	1.18	21574	578091	791571	24.97	491503
1992	32423	18253	14170	11.26	159591	1.24	3	52757	1.24	22653	538556	773558	23.86	436653
1993	33147	18253	14894	11.83	176131	1.30	3	58225	1.30	23786	495584	753725	22.74	386780
1994	33871	18253	15618	12.42	193926	1.37	3	64108	1.37	24975	448899	731908	21.61	341440
1995	34595	18253	16342	19.44	317680	1.44	20	470638	1.44	26284	463075	1277678	36.93	541860
1996	35318	18253	17065	20.01	341437	1.51	20	516060	1.51	27599	408145	1293241	36.62	498680
1997	36042	18253	17789	20.60	366521	1.59	20	564848	1.59	28978	348553	1308900	36.32	458761
1998	36766	18253	18513	21.23	393018	1.67	20	617224	1.67	30427	283932	1324602	36.03	422059
1999	37490	18253	19237	21.89	421023	1.75	20	673426	1.75	31949	213888	1340286	35.75	388233
2000	38214	18253	19961	22.58	450635	1.84	20	733705	1.84	33546	137996	1355882	35.48	357046
SUM					3491044			3972834				15125789		7814434

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D3 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10909.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	10253
CAPITAL COST, 1983 DOLLARS	6000000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	220000
ELECTRICAL COST, 1983 ($)	24000
WATER COST, 1983 ($)	3000
SEWER COST, 1983 ($)	1000
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10

NATURAL GAS COST, 1983 ($)	35000
FUEL COST, 1983 ($)	12000
MAINT & SUPP COST, 1983 ($)	96000
INSURANCE COST, 1983 ($)	29000
FIXED DISPOSAL COST (1983 $/ton)	0.00
VAR DISPOSAL COST (1983 $/ton)	7.26
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.26
VAR HAUL COST (1983$/ton-mile)	0.15
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	4
ALT FIXED DISP COST (1995 $/ton)	0.09

ALT VAR DISP COST (1995$/ton)	11.35
ALT FIXED HAUL (1995$/ton-mile)	0.08
ALT VAR HAUL (1995$/ton-mile)	0.15
ALTERNATIVE DISP DIST (miles)	20
ALTERNATIVE DISP REQUIRED BY	1995
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/yr)	84287
PRICE OF STEAM(1982$/Mlb)	5.82
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh)	2281625
PRICE OF ELECTRICITY($/kwh)	0.05

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	3919637	1925299
UNIFORM ANNUAL COST($)	515329	253126
UNIFORM ANNUAL COST($/TON)	28.23	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	10253	870	47.65	259	29	3	2	43	14	111	34	7301	8.40	61	0.43	4	13	570	31.21	643	150	647	35.44	647	10253	8.40	153	153
1987	10253	870	47.65	272	31	4	2	46	15	117	35	7301	8.82	64	0.44	4	13	599	32.83	688	160	621	34.02	565	10253	8.82	161	146
1988	10253	870	47.65	286	34	4	2	49	15	123	37	7301	9.27	68	0.45	4	13	630	34.54	736	171	593	32.47	490	10253	9.27	169	140
1989	10253	870	47.65	300	36	4	2	53	16	129	39	7301	9.73	71	0.46	4	13	663	36.34	788	183	562	30.79	422	10253	9.73	178	133
1990	10253	870	47.65	315	39	4	3	56	17	135	41	7301	10.22	75	0.47	4	14	698	38.23	843	196	529	28.96	361	10253	10.22	186	127
1991	10253	870	47.65	331	41	4	3	60	18	142	43	7301	10.73	78	0.48	4	14	734	40.22	902	210	492	26.97	306	10253	10.73	196	122
1992	10253	870	47.65	347	44	5	3	64	19	149	45	7301	11.26	82	0.49	4	14	773	42.33	965	224	453	24.81	256	10253	11.26	206	116
1993	10253	870	47.65	365	47	5	3	69	20	156	47	7301	11.83	86	0.50	4	15	813	44.54	1033	240	410	22.46	210	10253	11.83	216	111
1994	10253	870	47.65	383	51	5	3	74	21	164	50	7301	12.42	91	0.52	4	15	856	46.87	1105	257	364	19.92	170	10253	12.42	227	106
1995	10253	870	47.65	402	54	5	3	79	22	172	52	7301	19.44	142	0.23	20	34	965	52.89	1182	275	378	20.71	160	10253	19.44	355	150
1996	10253	870	47.65	422	58	6	3	84	23	181	55	7301	20.01	146	0.24	20	35	1013	55.48	1265	294	323	17.71	125	10253	20.01	365	141
1997	10253	870	47.65	444	62	6	4	90	24	190	57	7301	20.60	150	0.25	20	36	1063	58.22	1353	315	264	14.47	93	10253	20.60	376	132
1998	10253	870	47.65	466	66	6	4	97	25	200	60	7301	21.23	155	0.25	20	37	1115	61.10	1448	337	200	10.96	64	10253	21.23	387	123
1999	10253	870	47.65	489	71	7	4	103	26	210	63	7301	21.89	160	0.26	20	38	1171	64.14	1550	360	131	7.15	38	10253	21.89	399	116
2000	10253	870	47.65	513	76	7	4	111	28	220	66	7301	22.50	165	0.27	20	40	1229	67.35	1658	386	55	3.03	15	10253	22.50	412	109
SUM		13045												1505			343	12092				6021		3920				1925

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D3 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	0.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.58	3	17063	0.58	10565	646913	757129	26.96	757129
1987	28804	18253	10551	8.82	93104	0.61	3	19236	0.61	11093	620989	744423	25.84	676748
1988	29527	18253	11274	9.27	104466	0.64	3	21584	0.64	11648	592760	730459	24.74	603685
1989	30251	18253	11998	9.73	116733	0.67	3	24118	0.67	12230	562041	715122	23.64	537282
1990	30975	18253	12722	10.22	129964	0.70	3	26852	0.70	12842	528631	698289	22.54	476941
1991	31699	18253	13446	10.73	144227	0.74	3	29799	0.74	13484	492315	679825	21.45	422118
1992	32423	18253	14170	11.26	159591	0.78	3	32973	0.78	14158	452862	659585	20.34	372318
1993	33147	18253	14894	11.83	176131	0.81	3	36391	0.81	14866	410022	637410	19.23	327092
1994	33871	18253	15618	12.42	193926	0.86	3	40067	0.86	15609	363526	613129	18.10	286029
1995	34595	18253	16342	19.44	317680	0.90	20	294149	0.90	16428	377955	1006212	29.09	426732
1996	35318	18253	17065	20.01	341437	0.94	20	322537	0.94	17249	323347	1004570	28.44	387305
1997	36042	18253	17789	20.60	366521	0.99	20	353030	0.99	18112	264154	1001816	27.80	351130
1998	36766	18253	18513	21.23	393018	1.04	20	385765	1.04	19017	200018	997818	27.14	317936
1999	37490	18253	19237	21.89	421023	1.09	20	420891	1.09	19968	130553	992435	26.47	287473
2000	38214	18253	19961	22.58	450635	1.15	20	458565	1.15	20966	55343	985510	25.79	259516
SUM					3491044			2483021				12223732		6489434

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE 03 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	0.09		
ALT LANDFILL VAR CO: 1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.93	3	27301	0.93	16904	646913	773706	27.55	773706
1987	28804	18253	10551	8.82	93104	0.97	3	30778	0.97	17749	620989	762621	26.48	693291
1988	29527	18253	11274	9.27	104466	1.02	3	34534	1.02	18637	592760	750398	25.41	620163
1989	30251	18253	11998	9.73	116733	1.07	3	38589	1.07	19569	562041	736931	24.36	553667
1990	30975	18253	12722	10.22	129964	1.13	3	42963	1.13	20547	528631	722105	23.31	493208
1991	31699	18253	13446	10.73	144227	1.18	3	47678	1.18	21574	492315	705795	22.27	438243
1992	32423	18253	14170	11.26	159591	1.24	3	52757	1.24	22653	452862	687864	21.22	388281
1993	33147	18253	14894	11.83	176131	1.30	3	58225	1.30	23786	410022	668164	20.16	342874
1994	33871	18253	15618	12.42	193926	1.37	3	64108	1.37	24975	363526	646535	19.09	301614
1995	34595	18253	16342	19.44	317680	1.44	20	470638	1.44	26284	377955	1192558	34.47	505761
1996	35318	18253	17065	20.01	341437	1.51	20	516060	1.51	27599	323347	1208442	34.22	465907
1997	36042	18253	17789	20.60	366521	1.59	20	564048	1.59	28978	264154	1224501	33.97	429180
1998	36766	18253	18513	21.23	393018	1.67	20	617224	1.67	30427	200018	1240687	33.75	395321
1999	37490	18253	19237	21.89	421023	1.75	20	673426	1.75	31949	130553	1256951	33.53	364094
2000	38214	18253	19961	22.58	450635	1.84	20	733705	1.84	33546	55343	1273229	33.32	335201
SUM					3491044			3972834				13850486		7180591

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE 04 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986
FACILITY CAPACITY(TONS/YR)	18253
CAPITAL COST, 1983 DOLLARS	6000000
CAP AMORTIZATION PERIOD(YRS)	15
CAP AMORTIZATION RATE(%)	10
ENERGY ESCALATION RATE(%)	7
LABOR COST, 1983 ($)	224000
ELECTRICAL COST, 1983 ($)	24000
WATER COST, 1983 ($)	3000
SEWER COST, 1983 ($)	1800
GEN O&M ESCALATION RATE (%)	5
PRES WORTH DISCOUNT RATE (%)	10
NATURAL GAS COST, 1983 ($)	35000
FUEL COST, 1983 ($)	12000
MAINT & SUPP COST, 1983 ($)	96000
INSURANCE COST, 1983 ($)	29000
FIXED DISPOSAL COST (1983 $/ton)	0.00
VAR DISPOSAL COST (1983 $/ton)	7.26
DISPOSAL ESCALATION RATE (%)	5
FIXED HAUL COST (1983$/ton-mile)	0.26
VAR HAUL COST (1983$/ton-mile)	0.15
DISP HAUL ESCALATION RATE (%)	5
DISP HAUL DISTANCE (miles)	4
ALT FIXED DISP COST (1995 $/ton)	8.09
ALT VAR DISP COST (1995$/ton)	11.35
ALT FIXED HAUL (1995$/ton-mile)	0.08
ALT VAR HAUL (1995$/ton-mile)	0.15
ALTERNATIVE DISP DIST (miles)	20
ALTERNATIVE DISP REQUIRED BY	1995
ALTERNATIVE DISP ESC RATE (%)	5
STEAM GENERATED(Mlb/yr)	84287
PRICE OF STEAM(1982$/Mlb)	5.82
STEAM COST ESCALATION RATE(%)	7
ELECTRICITY GENERATED(kwh)	2281625
PRICE OF ELECTRICITY($/kwh)	0.06

*************************** SUMMARY ***************************

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	3547329	1925299
UNIFORM ANNUAL COST($)	466381	253126
UNIFORM ANNUAL COST($/TON)	25.55	13.87

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	1000$	$/ton	1000$	1000$
1986	18253	870	47.65	259	29	3	2	43	14	111	34	7301	8.40	61	0.43	4	13	570	31.21	643	179	617	33.80	617	18253	8.40	153	153
1987	18253	870	47.65	272	31	4	2	46	15	117	35	7301	8.82	64	0.44	4	13	599	32.83	688	192	589	32.27	535	18253	8.82	161	146
1988	18253	870	47.65	286	34	4	2	49	15	123	37	7301	9.27	68	0.45	4	13	630	34.54	736	205	559	30.60	462	18253	9.27	169	140
1989	18253	870	47.65	300	36	4	2	53	16	129	39	7301	9.73	71	0.46	4	13	663	36.34	788	220	525	28.78	395	18253	9.73	178	133
1990	18253	870	47.65	315	39	4	3	56	17	135	41	7301	10.22	75	0.47	4	14	698	38.23	843	235	489	26.81	334	18253	10.22	186	127
1991	18253	870	47.65	331	41	4	3	60	18	142	43	7301	10.73	78	0.48	4	14	734	40.22	902	252	450	24.67	280	18253	10.73	196	122
1992	18253	870	47.65	347	44	5	3	64	19	149	45	7301	11.26	82	0.49	4	14	773	42.33	965	269	408	22.35	230	10253	11.26	206	116
1993	18253	870	47.65	365	47	5	3	69	20	156	47	7301	11.83	86	0.50	4	15	813	44.54	1033	288	362	19.83	186	18253	11.83	216	111
1994	18253	870	47.65	383	51	5	3	74	21	164	50	7301	12.42	91	0.52	4	15	856	46.87	1105	308	312	17.10	146	18253	12.42	227	106
1995	18253	870	47.65	402	54	5	3	79	22	172	52	7301	19.44	142	0.23	20	34	965	52.89	1182	330	323	17.69	137	18253	19.44	355	150
1996	18253	870	47.65	422	58	6	3	84	23	181	55	7301	20.01	146	0.24	20	35	1013	55.48	1265	353	265	14.49	102	18253	20.01	365	141
1997	18253	870	47.65	444	62	6	4	90	24	190	57	7301	20.60	150	0.25	20	36	1063	58.22	1353	378	201	11.02	71	18253	20.60	376	132
1998	18253	870	47.65	466	66	6	4	97	25	200	60	7301	21.23	155	0.25	20	37	1115	61.10	1448	404	133	7.27	42	18253	21.23	387	123
1999	18253	870	47.65	489	71	7	4	103	26	210	63	7301	21.89	160	0.26	20	38	1171	64.14	1550	432	58	3.20	17	18253	21.89	399	116
2000	18253	870	47.65	513	76	7	4	111	28	220	66	7301	22.58	165	0.27	20	40	1229	67.35	1658	463	-22	-1.19	-6	18253	22.58	412	109
SUM		13045												1595			343	12892				5270		3547				1925

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D4 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	0.90
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.58	3	17063	0.58	10565	617006	727221	25.90	727221
1987	28804	18253	10551	8.82	93104	0.61	3	19236	0.61	11093	588988	712422	24.73	647656
1988	29527	18253	11274	9.27	104466	0.64	3	21584	0.64	11648	558519	696218	23.58	575386
1989	30251	18253	11998	9.73	116733	0.67	3	24118	0.67	12230	525403	678484	22.43	509755
1990	30975	18253	12722	10.22	129964	0.70	3	26852	0.70	12842	489428	659086	21.28	450165
1991	31699	18253	13446	10.73	144227	0.74	3	29799	0.74	13484	450369	637878	20.12	396072
1992	32423	18253	14170	11.26	159591	0.78	3	32973	0.78	14158	407979	614702	18.96	346983
1993	33147	18253	14894	11.83	176131	0.81	3	36391	0.81	14866	361997	589385	17.78	302448
1994	33871	18253	15618	12.42	193926	0.86	3	40067	0.86	15609	312140	561743	16.58	262057
1995	34595	18253	16342	19.44	317680	0.90	20	294149	0.90	16428	322971	951228	27.50	403414
1996	35318	18253	17065	20.01	341437	0.94	20	322537	0.94	17249	264514	945738	26.78	364623
1997	36042	18253	17789	20.60	366521	0.99	20	353030	0.99	18112	201203	938865	26.05	329066
1998	36766	18253	18513	21.23	393018	1.04	20	385765	1.04	19017	132661	930461	25.31	296474
1999	37490	18253	19237	21.89	421023	1.09	20	420891	1.09	19968	58480	920363	24.55	266596
2000	38214	18253	19961	22.58	450635	1.15	20	458565	1.15	20966	-21774	908393	23.77	239208
SUM					3491044			2483021				11472187		6117125

PART II

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE D4 - RESOURCE RECOVERY, 100 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1995
FACILITY CAPACITY(TONS/YR)	18253	ALT FIXED HAUL COST (1995$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1995$/ton-mile)	1.44
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.80
LF VAR HAUL COST (1983$/ton-mile)	0.80	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	1
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1995$/ton)	8.09		
ALT LANDFILL VAR COST (1995$/ton)	11.35		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28080	18253	9827	8.40	82587	0.93	3	27301	0.93	16904	617006	743798	26.49	743798
1987	28804	18253	10551	8.82	93104	0.97	3	30778	0.97	17749	588988	730620	25.37	664200
1988	29527	18253	11274	9.27	104466	1.02	3	34534	1.02	18637	558519	716157	24.25	591865
1989	30251	18253	11998	9.73	116733	1.07	3	38589	1.07	19569	525403	700293	23.15	526141
1990	30975	18253	12722	10.22	129964	1.13	3	42963	1.13	20547	489428	682903	22.05	466432
1991	31699	18253	13446	10.73	144227	1.18	3	47678	1.18	21574	450369	663848	20.94	412197
1992	32423	18253	14170	11.26	159591	1.24	3	52757	1.24	22653	407979	642981	19.83	362946
1993	33147	18253	14894	11.83	176131	1.30	3	58225	1.30	23786	361997	620139	18.71	318229
1994	33871	18253	15618	12.42	193926	1.37	3	64108	1.37	24975	312140	595149	17.57	277641
1995	34595	18253	16342	19.44	317680	1.44	20	470638	1.44	26284	322971	1137574	32.88	482442
1996	35318	18253	17065	20.01	341437	1.51	20	516060	1.51	27599	264514	1149610	32.55	443224
1997	36042	18253	17789	20.60	366521	1.59	20	564848	1.59	28978	201203	1161550	32.23	407116
1998	36766	18253	18513	21.23	393018	1.67	20	617224	1.67	30427	132661	1173330	31.91	373859
1999	37490	18253	19237	21.89	421023	1.75	20	673426	1.75	31949	58480	1184878	31.61	343217
2000	38214	18253	19961	22.58	450635	1.84	20	733705	1.84	33546	-21774	1196112	31.30	314974
SUM					3491044			3972834				13098941		6728282

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE C1 - RESOURCE RECOVERY,136 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($/TON)	2.87	ALT VAR DISP COST (1996$/ton)	11.92
FACILITY CAPACITY(TONS/YR)	VARIES	FUEL COST, 1983 ($/TON)	0.71	ALT FIXED HAUL (1996$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	6311000	MAINT & SUPP COST, 1983 ($/TON)	5.78	ALT VAR HAUL (1996$/ton-mile)	0.16
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	36000	ALTERNATIVE DISP DIST (miles)	23
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.80	ALTERNATIVE DISP REQUIRED BY	1996
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	323000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/TON)	0
ELECTRICAL COST, 1983 ($/TON)	1.42	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1983$/Mlb)	0.00
WATER COST, 1983 ($/TON)	0.10	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($/TON)	0.11	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh/TON)	125
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	1	PRICE OF ELECTRICITY($/kwh)	0.05
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1996 $/ton)	0.49		

SUMMARY

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	14610920	2405352
UNIFORM ANNUAL COST($)	1920953	326759
UNIFORM ANNUAL COST($/TON)	82.26	13.99

Table part 1: waste, capital cost and operation and maintenance costs

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton
1986	19783	944	47.71	374	34	4	3	50	16	131	42	7913	8.40	67	0.43	1	3	724	36.57
1987	20293	944	46.51	393	38	4	3	55	18	141	44	8117	8.82	72	0.44	1	4	770	37.93
1988	20803	944	45.37	412	41	5	3	60	19	151	46	8321	9.27	77	0.45	1	4	819	39.36
1989	21313	944	44.28	433	45	5	3	66	20	163	48	8525	9.73	83	0.46	1	4	871	40.87
1990	21823	944	43.25	454	50	6	3	73	22	175	51	8729	10.22	89	0.47	1	4	926	42.45
1991	22333	944	42.26	477	54	6	4	79	23	188	53	8933	10.73	96	0.48	1	4	986	44.13
1992	22843	944	41.32	501	60	6	4	87	25	202	56	9137	11.26	103	0.49	1	5	1048	45.89
1993	23353	944	40.41	526	65	7	4	95	27	217	59	9341	11.83	110	0.50	1	5	1115	47.75
1994	23863	944	39.55	552	71	7	4	104	29	233	62	9545	12.42	119	0.52	1	5	1186	49.71
1995	24373	944	38.72	580	78	8	5	114	31	249	65	9749	13.04	127	0.53	1	5	1262	51.77
1996	24883	944	37.93	609	85	8	5	124	33	267	68	9953	22.29	222	0.27	23	61	1483	59.61
1997	25393	944	37.17	640	93	9	6	136	36	287	71	10157	22.98	233	0.27	23	64	1574	61.97
1998	25903	944	36.43	671	101	10	6	148	38	307	75	10361	23.70	246	0.28	23	68	1670	64.47
1999	26413	944	35.73	705	111	10	6	161	41	329	79	10565	24.46	258	0.29	23	72	1772	67.09
2000	26923	944	35.05	740	123	11	7	176	44	352	83	10769	25.26	272	0.31	23	76	1881	69.86
SUM		14157												2174			382	10896	

Table part 2: revenues, resource recovery and landfill costs

YEAR	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	1000$	1000$	1000$	$	1000$	tons	$/ton	1000$	1000$
1986	0	151	1516	76.62	1516	19783	8.40	166	166
1987	0	166	1547	76.24	1407	20293	8.82	179	163
1988	0	182	1580	75.96	1306	20803	9.27	193	159
1989	0	200	1615	75.77	1213	21313	9.73	207	156
1990	0	219	1651	75.66	1128	21823	10.22	223	152
1991	0	240	1689	75.65	1049	22333	10.73	240	149
1992	0	262	1730	75.72	976	22843	11.26	257	145
1993	0	287	1772	75.87	909	23353	11.83	276	142
1994	0	314	1816	76.10	847	23863	12.42	296	138
1995	0	343	1863	76.42	790	24373	13.04	318	135
1996	0	375	2052	82.47	791	24883	22.29	555	214
1997	0	409	2100	83.02	739	25393	22.98	584	205
1998	0	447	2167	83.66	690	25903	23.70	614	196
1999	0	487	2229	84.37	646	26413	24.46	646	187
2000	0	532	2293	85.17	604	26923	25.26	680	179
SUM			27628		14611				2485

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE E1 - RESOURCE RECOVERY, 136 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1996
FACILITY CAPACITY(TONS/YR)	VARIES	ALT FIXED HAUL COST (1996$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1996$/ton-mile)	0.94
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	3
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1996$/ton)	8.49		
ALT LANDFILL VAR COST (1996$/ton)	11.92		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28079	19783	8296	8.40	69727	0.58	3	14406	0.58	34352	1515843	1634328	58.20	1634328
1987	28803	20293	8510	8.82	75100	0.61	3	15517	0.61	36999	1547204	1674821	58.15	1522565
1988	29527	20803	8724	9.27	80837	0.64	3	16702	0.64	39826	1580172	1717537	58.17	1419452
1989	30251	21313	8938	9.73	86960	0.67	3	17967	0.67	42842	1614818	1762588	58.27	1324258
1990	30975	21823	9152	10.22	93493	0.70	3	19317	0.70	46061	1651222	1810093	58.44	1236318
1991	31699	22333	9366	10.73	100462	0.74	3	20757	0.74	49494	1689464	1860177	58.68	1155023
1992	32423	22843	9580	11.26	107894	0.78	3	22292	0.78	53155	1729625	1912967	59.00	1079820
1993	33147	23353	9794	11.83	115819	0.81	3	23929	0.81	57059	1771793	1968601	59.39	1010203
1994	33871	23863	10008	12.42	124265	0.86	3	25675	0.86	61221	1816057	2027218	59.85	945712
1995	34595	24373	10222	13.04	133267	0.90	3	27535	0.90	65656	1862509	2088967	60.38	885926
1996	35318	24883	10435	21.01	219207	0.99	20	205995	0.99	73679	2052144	2551025	72.23	983530
1997	36042	25393	10649	21.63	230364	1.04	20	220728	1.04	78948	2108224	2638264	73.20	924695
1998	36766	25903	10863	22.29	242129	1.09	20	236420	1.09	84560	2166975	2730084	74.26	869889
1999	37490	26413	11077	22.98	254539	1.14	20	253129	1.14	90537	2228514	2826718	75.40	818800
2000	38214	26923	11291	23.70	267634	1.20	20	270917	1.20	96899	2292961	2928411	76.63	771142
SUM					2201698			1391286				32131798		16581662

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE E2 - RESOURCE RECOVERY,136 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($/TON)	2.87	ALT VAR DISP COST (1996$/ton)	11.92
FACILITY CAPACITY(TONS/YR)	VARIES	FUEL COST, 1983 ($/TON)	0.71	ALT FIXED HAUL (1996$/ton-mile)	0.08
CAPITAL COST, 1983 DOLLARS	6511000	MAINT & SUPP COST, 1983 ($/TON)	5.70	ALT VAR HAUL (1996$/ton-mile)	0.16
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	36000	ALTERNATIVE DISP DIST (miles)	23
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	0.00	ALTERNATIVE DISP REQUIRED BY	1996
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	7.26	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	323000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/TON)	0
ELECTRICAL COST, 1983 ($/TON)	1.42	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1983$/Mlb)	0.00
WATER COST, 1983 ($/TON)	0.18	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($/TON)	0.11	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh/TON)	125
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	1	PRICE OF ELECTRICITY($/kwh)	0.06
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (1996 $/ton)	8.49		

************************** SUMMARY **************************

	RESOURCE RECOVERY	LAND FILL
NET PRESENT VALUE($)	14170752	2485352
UNIFORM ANNUAL COST($)	1863082	326759
UNIFORM ANNUAL COST($/TON)	79.78	13.99

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL COSTS UNIT	LANDFILL COSTS TOTAL	LANDFILL COSTS PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	tons	$/ton	1000$	1000$
1986	19783	944	47.71	374	34	4	3	50	16	131	42	7913	8.40	67	0.43	1	3	724	36.57	0	182	1486	75.09	1486	19783	8.40	166	166
1987	20293	944	46.51	393	38	4	3	55	18	141	44	8117	8.82	72	0.44	1	4	770	37.93	0	199	1514	74.60	1376	20293	8.82	179	163
1988	20803	944	45.37	412	41	5	3	60	19	151	46	8321	9.27	77	0.45	1	4	819	39.36	0	219	1544	74.21	1276	20803	9.27	193	159
1989	21313	944	44.28	433	45	5	3	66	20	163	48	8525	9.73	83	0.46	1	4	871	40.87	0	240	1575	73.89	1183	21313	9.73	207	156
1990	21823	944	43.25	454	50	6	3	73	22	175	51	8729	10.22	89	0.47	1	4	926	42.45	0	263	1607	73.66	1098	21823	10.22	223	152
1991	22333	944	42.26	477	54	6	4	79	23	188	53	8933	10.73	96	0.48	1	4	986	44.13	0	288	1641	73.50	1019	22333	10.73	240	149
1992	22843	944	41.32	501	60	6	4	87	25	202	56	9137	11.26	103	0.49	1	5	1048	45.89	0	315	1677	73.42	947	22843	11.26	257	145
1993	23353	944	40.41	526	65	7	4	95	27	217	59	9341	11.83	110	0.50	1	5	1115	47.75	0	345	1714	73.41	880	23353	11.83	276	142
1994	23863	944	39.55	552	71	7	4	104	29	233	62	9545	12.42	119	0.52	1	5	1186	49.71	0	377	1753	73.47	818	23863	12.42	296	138
1995	24373	944	38.72	580	78	8	5	114	31	249	65	9749	13.04	127	0.53	1	5	1262	51.77	0	412	1794	73.60	761	24373	13.04	318	135
1996	24883	944	37.93	609	85	8	5	124	33	267	68	9953	22.29	222	0.27	23	61	1403	59.61	0	450	1977	79.46	762	24883	22.29	555	214
1997	25393	944	37.17	640	93	9	6	136	36	287	71	10157	22.98	233	0.27	23	64	1574	61.97	0	491	2026	79.80	710	25393	22.98	584	205
1998	25903	944	36.43	671	101	10	6	148	38	307	75	10361	23.70	246	0.28	23	68	1670	64.47	0	536	2078	80.21	662	25903	23.70	614	196
1999	26413	944	35.73	705	111	10	6	161	41	329	79	10565	24.46	258	0.29	23	72	1772	67.09	0	585	2131	80.68	617	26413	24.46	646	187
2000	26923	944	35.05	740	121	11	7	176	44	352	83	10769	25.26	272	0.31	23	76	1881	69.86	0	638	2187	81.22	576	26923	25.26	680	179
SUM		14157												2174			382	18086				26705		14171				2485

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE E2 - RESOURCE RECOVERY, 136 TPD FACILITY

PROJECT NO. 10989.100
NOVEMBER 25, 1983
BOZEMAN LANDFILL SERVICE AREA

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	ALTERNATE LANDFILL REQUIRED BY	1996
FACILITY CAPACITY(TONS/YR)	VARIES	ALT FIXED HAUL COST (1996$/ton-mile)	0.00
LANDFILL FIXED COST (1983$/ton)	0.00	ALT VAR HAUL COST (1996$/ton-mile)	0.94
LANDFILL VAR COST (1983$/ton)	7.26	ALTERNATE LANDFILL DISTANCE (miles)	20
LANDFILL ESCALATION RATE(%)	5	RECOVERY FIXED HAUL COST(1983$/ton-mile)	0.00
LF FIXED HAUL COST(1983$/ton-mile)	0.00	RECOVERY VAR HAUL COST(1983$/ton-mile)	0.50
LF VAR HAUL COST (1983$/ton-mile)	0.50	RECOVERY HAUL ESCALATION RATE(%)	5
LANDFILL HAUL ESCALATION RATE(%)	5	RECOVERY HAUL DISTANCE(miles)	3
LANDFILL DISTANCE (MILES)	3	PRESENT WORTH DISCOUNT RATE (%)	10
ALT LANDFILL FIXED COST (1996$/ton)	8.49		
ALT LANDFILL VAR COST (1996$/ton)	11.92		

YEAR	ANNUAL SOLID WASTE	WASTE TO RECOVERY FACILITY	WASTE TO LANDFILL	LANDFILL COST unit	LANDFILL COST total	HAUL TO LANDFILL COST unit	HAUL TO LANDFILL COST distance	HAUL TO LANDFILL COST total	HAUL TO RECOVERY FACILITY COST unit	HAUL TO RECOVERY FACILITY COST total	RESOURCE RECOVERY FACILITY COST	TOTAL SOLID WASTE SYSTEM COSTS total	TOTAL SOLID WASTE SYSTEM COSTS unit	SYSTEM PRESENT WORTH COST
	tons	tons	tons	$/ton	$	$/ton-mi	miles	$	$/ton-mi	$	$	$	$/ton	$
1986	28079	19783	8296	8.40	69727	0.58	3	14406	0.58	34352	1485549	1604034	57.12	1604034
1987	28803	20293	8510	8.82	75100	0.61	3	15517	0.61	36999	1513955	1641571	56.99	1492337
1988	29527	20803	8724	9.27	80837	0.64	3	16702	0.64	39826	1543700	1681065	56.93	1389310
1989	30251	21313	8938	9.73	86960	0.67	3	17967	0.67	42842	1574837	1722607	56.94	1294220
1990	30975	21823	9152	10.22	93493	0.70	3	19317	0.70	46061	1607419	1766289	57.02	1206399
1991	31699	22333	9366	10.73	100462	0.74	3	20757	0.74	49494	1641498	1812211	57.17	1125241
1992	32423	22843	9580	11.26	107894	0.78	3	22292	0.78	53155	1677130	1860472	57.38	1050188
1993	33147	23353	9794	11.83	115819	0.81	3	23929	0.81	57059	1714370	1911177	57.66	980736
1994	33871	23863	10008	12.42	124265	0.86	3	25675	0.86	61221	1753272	1964433	58.00	916423
1995	34595	24373	10222	13.04	133267	0.90	3	27535	0.90	65656	1793893	2020351	58.40	856826
1996	35318	24883	10435	21.01	219207	0.99	20	205995	0.99	73679	1977189	2476069	70.11	954632
1997	36042	25393	10649	21.63	230364	1.04	20	220728	1.04	78948	2026378	2556418	70.93	896009
1998	36766	25903	10863	22.29	242129	1.09	20	236420	1.09	84560	2077641	2640750	71.83	841424
1999	37490	26413	11077	22.98	254539	1.14	20	253129	1.14	90537	2131045	2729249	72.80	790566
2000	38214	26923	11291	23.70	267634	1.20	20	270917	1.20	96899	2186655	2822105	73.85	743148
SUM					2201698			1391286				31208803		16141494

PART I

GALLATIN COUNTY, MONTANA
SOLID WASTE MANAGEMENT AND RESOURCE RECOVERY STUDY
ALTERNATIVE F1 - RESOURCE RECOVERY, 200 TPD FACILITY

PROJECT NO. 10555.100
DECEMBER 16,1983
TOTAL COUNTY

ASSUMPTIONS:

YEAR FACILITY OPERABLE	1986	NATURAL GAS COST, 1983 ($/TON)	2.07	ALT VAR DISP COST (2005$/ton)	0.00
FACILITY CAPACITY(TONS/YR)	VARIES	FUEL COST, 1983 ($/TON)	0.71	ALT FIXED HAUL (2005$/ton-mile)	0.00
CAPITAL COST, 1983 DOLLARS	9710000	MAINT & SUPP COST, 1983 ($/TON)	5.70	ALT VAR HAUL (2005$/ton-mile)	0.00
CAP AMORTIZATION PERIOD(YRS)	15	INSURANCE COST, 1983 ($)	50000	ALTERNATIVE DISP DIST (miles)	0
CAP AMORTIZATION RATE(%)	10	FIXED DISPOSAL COST (1983 $/ton)	2.75	ALTERNATIVE DISP REQUIRED BY	2005
ENERGY ESCALATION RATE(%)	7	VAR DISPOSAL COST (1983 $/ton)	11.02	ALTERNATIVE DISP ESC RATE (%)	5
LABOR COST, 1983 ($)	404000	DISPOSAL ESCALATION RATE (%)	5	STEAM GENERATED(Mlb/TON)	84287
ELECTRICAL COST, 1983 ($/TON)	1.42	FIXED HAUL COST (1983$/ton-mile)	0.26	PRICE OF STEAM(1983$/Mlb)	6.23
WATER COST, 1983 ($/TON)	0.18	VAR HAUL COST (1983$/ton-mile)	0.15	STEAM COST ESCALATION RATE(%)	7
SEWER COST, 1983 ($/TON)	0.11	DISP HAUL ESCALATION RATE (%)	5	ELECTRICITY GENERATED(kwh/TON)	125
GEN O&M ESCALATION RATE (%)	5	DISP HAUL DISTANCE (miles)	25	PRICE OF ELECTRICITY($/kwh)	0.05
PRES WORTH DISCOUNT RATE (%)	10	ALT FIXED DISP COST (2005 $/ton)	0.00		

SUMMARY

	RESOURCE RECOVERY	LANDFILL
NET PRESENT VALUE($)	14051674	5124283
UNIFORM ANNUAL COST($)	1847427	673709
UNIFORM ANNUAL COST($/TON)	57.90	21.11

YEAR	WASTE TO RES REC FAC	CAPITAL COST total	CAPITAL COST unit	LABOR COST	ELEC COST	WATER COST	SEWER COST	GAS COST	FUEL COST	SUPP COST	INSUR COST	RESIDUE DISPOSAL amount	RESIDUE DISPOSAL unit	RESIDUE DISPOSAL total	RESIDUE DISPOSAL HAUL unit	RESIDUE DISPOSAL HAUL dist	RESIDUE DISPOSAL HAUL total	TOTAL O & M total	TOTAL O & M unit	REVENUES STEAM	REVENUES ELEC	RES REC NET COST	TIP FEE	RES REC PRESENT WORTH @COST	LANDFILL COSTS WASTE AMOUNT	LANDFILL UNIT	LANDFILL TOTAL	LANDFILL PRESENT WORTH
	tons	1000$	$/ton	1000$	1000$	1000$	1000$	1000$	1000$	1000$	1000$	tons	$/ton	1000$	$/ton-m	miles	1000$	1000$	$/ton	1000$	1000$	1000$	$	1000$	tons	$/ton	1000$	1000$
1986	27210	1409	51.77	468	47	6	3	69	22	180	58	10884	15.51	169	0.43	25	118	1140	41.89	643	223	1682	61.82	1682	27210	15.51	422	422
1987	27881	1409	50.52	491	52	6	4	76	24	193	61	11152	16.14	180	0.44	25	123	1210	43.39	680	244	1686	60.46	1532	27881	16.14	450	409
1988	28552	1409	49.34	516	57	7	4	83	26	208	64	11421	16.81	192	0.45	25	129	1284	44.98	736	260	1689	59.14	1396	28552	16.81	480	397
1989	29223	1409	48.28	541	62	7	4	91	28	223	67	11689	17.52	205	0.46	25	135	1363	46.65	788	293	1691	57.85	1270	29223	17.52	512	385
1990	29894	1409	47.12	568	68	8	5	99	30	240	70	11958	18.26	218	0.47	25	141	1447	48.41	843	321	1692	56.59	1155	29894	18.26	546	373
1991	30565	1409	46.09	597	75	8	5	109	32	257	74	12226	19.03	233	0.48	25	147	1536	50.27	902	351	1692	55.35	1050	30565	19.03	582	361
1992	31236	1409	45.10	627	82	9	5	119	34	276	78	12494	19.85	248	0.49	25	154	1631	52.22	965	384	1690	54.12	954	31236	19.85	620	350
1993	31907	1409	44.15	658	89	9	6	130	37	296	81	12763	20.70	264	0.50	25	161	1732	54.28	1033	420	1688	52.90	866	31907	20.70	660	339
1994	32578	1409	43.24	691	97	10	6	142	40	318	86	13031	21.60	281	0.52	25	168	1839	56.44	1105	459	1684	51.68	785	32578	21.60	704	328
1995	33249	1409	42.37	726	106	11	7	155	42	340	90	13300	22.54	300	0.53	25	176	1953	58.72	1183	501	1678	50.46	712	33249	22.54	749	316
1996	33920	1409	41.53	762	116	12	7	169	45	365	94	13568	23.53	319	0.54	25	184	2073	61.12	1265	547	1670	49.23	644	33920	23.53	798	308
1997	34591	1409	40.72	800	127	12	8	185	49	390	99	13836	24.57	340	0.56	25	193	2202	63.65	1354	596	1660	47.98	582	34591	24.57	850	296
1998	35262	1409	39.95	840	138	13	8	201	52	418	104	14105	25.66	362	0.57	25	202	2330	66.31	1449	651	1647	46.72	525	35262	25.66	905	288
1999	35933	1409	39.20	882	151	14	9	220	56	447	109	14373	26.81	385	0.59	25	211	2483	69.10	1550	709	1632	45.42	473	35933	26.81	963	279
2000	36604	1409	38.48	926	164	15	9	239	60	478	115	14642	28.01	410	0.60	25	221	2637	72.05	1659	773	1614	44.09	425	36604	28.01	1025	270
SUM		21129												4106			2463	26069				25093		14052				5124